PB82-230616

Harrington Station Unit 2 Fabric Filter System
Special Testing Report

Southwestern Public Service Co.
Amarillo, TX

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Oct 81

U.S. Department of Commerce
National Technical Information Service
NTIS

PB82-230616

EPA-600/7-81-168
October 1981

Harrington Station Unit 2 Fabric Filter System

Special Testing Report

October 1981

by

Kenneth Ladd, Olon Plunk, Steve Thurman, Larry Pinson,
Leo Fajardo, Dean Metcalf and Sherry Kunka

Southwestern Public Service Company
P. O. Box 1261
Amarillo, Texas 79170

Contract No. 68-02-2659
Program Element No. EHE624A

EPA Project Officer: Dale L. Harmon

Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, NC 27711

Prepared for

U. S. Environmental Protection Agency
Office of Research and Development
Washington, DC 20460

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/7-81-168	2.	3. RECIPIENT'S ACCESSION NO. PB82 230616
4. TITLE AND SUBTITLE Harrington Station Unit 2 Fabric Filter System Special Testing Report		5. REPORT DATE October 1981
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) K. Ladd, O. Plunk, S. Thurman, L. Pinson, L. Fajardo, D. Metcalf, and S. Kunka		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Southwestern Public Service Company P.O. Box 1261 Amarillo, Texas 79170		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-02-2659
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Final; 12/78-7/81
		14. SPONSORING AGENCY CODE EPA/600/13

15. SUPPLEMENTARY NOTES IERL-RTP project officer is Dale L. Harmon, Mail Drop 61, 919/541-2925.

16. ABSTRACT The report gives results of a special test program to determine mass emissions of particulate, SO2, and NOx from a large utility baghouse controlling emissions from a boiler firing low-sulfur Western coal. The tests verified that NOx emissions, measured by EPA Method 7, were not significantly affected by the baghouse. Emissions of SO2 measured consistently below the New Source Performance Standard of 1.2 lb/million Btu at a level of about 0.8 lb/million Btu. Particulate tests indicated an average emission rate of 0.028 lb/million Btu. Overall test results indicate that Southwestern's Harrington Station, using low-sulfur and low-ash Western coal, can operate consistently within all applicable mass emission rates while using a fabric filter for air quality control.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Pollution	Dust	Pollution Control	13B	11G
Fabrics	Aerosols	Stationary Sources	11E	
Filtration	Sulfur Dioxide	Fabric Filters	07D	07B
Flue Gases	Nitrogen Oxides	Baghouses	21B	
Coal		Particulate	21D	
Combustion				

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 150
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED US BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.

DISCLAIMER

This report has been reviewed by the Industrial Environmental Research Laboratory, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Preceding page blank

ABSTRACT

A special test program was conducted by Southwestern Public Service Company to determine mass emissions of particulate, sulfur dioxides, and oxides of nitrogen from a large utility baghouse controlling emissions from a boiler firing low sulfur Western coal. The sampling was conducted in four phases. The first phase conducted in December 1978 verified that NO_x emissions, as measured by EPA Method 7, were not significantly affected by the baghouse. Emissions of SO_2 measured consistently below the New Source Performance Standard of 1.2 lb/10^6 Btu at a level of approximately 0.8 lb/10^6 Btu. Particulate tests indicated an average emission rate of 0.028 lb/10^6 Btu. Overall results of the special testing program indicate that Southwestern's Harrington Station, using low sulfur and low ash Western coal, can consistently operate within all applicable mass emission rates while using a fabric filter for air quality control.

CONTENTS

	Page
Abstract	vi
List of Figures	viii
List of Tables	ix
Conversion Table	
I. Introduction and Background	1
II. Conclusions	3
III. Harrington Station Description	4
IV. Equipment, Methods, Calibration Procedures	7
V. SPS Test Phases and Results	88

Appendices
- A. Coal Analysis
- B. Raw Field Data
- C. Field Notes

LIST OF FIGURES

Number		Page
Figure IV-1	Lear Siegler Console	8
Figure IV-2	Pump Flow Diagram	9
Figure IV-3	Manual Sampling Probe	10
Figure IV-4	Probe Liner Supports	11
Figure IV-5	Method of Wrapping Nichrome Wire	12
Figure IV-6	Attachment of Pitot Tube Lines and Thermocouple Casing	13
Figure IV-7	Type S Pitot Tubes	14
Figure IV-8	Umbilical Cord	15
Figure IV-9	Probe Extension	17
Figure IV-10	Vertical Sampling Set-up	18
Figure IV-11	Stack Sampling Set-up	19
Figure IV-12	Form for Calibration of Standard Volume Flasks	20
Figure IV-13	Flask and Wet Test Meter Hook-up	22
Figure IV-14	Form for Wet Test Meter Calibration	23
Figure IV-15	Sampling Console and Wet Test Meter Hook-up	24
Figure IV-16	Form for Pre-Calibration Leak Check	26
Figure IV-17	Dry Gas Meter Calibration Form	27
Figure IV-18	Orifice Calibration Form	28
Figure IV-19	Form for Standardization of Thermometers	30
Figure IV-20	Magnehelic Connection to Inclined Manometer	31
Figure IV-21	Form for Magnehelic Calibration	33
Figure IV-22	Probe Heater Check Form	34
Figure IV-23	Pitot Tube Calibration Form	35
Figure IV-24	Orsat Bag Evacuation	37
Figure IV-25	Combustion Gas Sampling Train	39
Figure IV-26	Gas Analysis Data Sheet	40
Figure IV-27	Orsat Analyzer	41
Figure IV-28	Particulate Sampling Train	43
Figure IV-29	Particulate Data Sheet	44
Figure IV-30	Particulate Field Data Form	46
Figure IV-31	Moisture Fraction Form	47
Figure IV-32	Checklist for Recovery of Particulate Samples	48
Figure IV-33	Particulate Blank Results	50
Figure IV-34	Particulate Results	51
Figure IV-35	Acetone Purity Check Form	52
Figure IV-36	SO_2 Sampling Train	55
Figure IV-37	SO_2 Sample Field Data Form	57
Figure IV-38	Bottle Label	58
Figure IV-39	Checklist for Recovery of SO_2 Samples	59
Figure IV-40	SO_2 Analysis Form	60
Figure IV-41	SO_2 Data Summary	61
Figure IV-42	Isoproponal Check for Peroxide Impurity	64
Figure IV-43	Standardization of Barium Perchlorate	65
Figure IV-44	Standardization of NaOH	66

Figure IV-45 Standardization of H_2SO_4 67
Figure IV-46 SO_2 Quality Assurance Samples 72
Figure IV-47 Assembly of NO_x Sample Train 74
Figure IV-48 Flask Stopcock Positions 74
Figure IV-49 NO_x Sampling Data Form 75
Figure IV-50 NO_x Analysis Sheet 77
Figure IV-51 Analysis of Standards for NO_x 81
Figure IV-52 Method 5 Dry Gas Meter Inter-Laboratory Survey 87
Figure V-1 Fabric Installation, July 1979 91

LIST OF TABLES

Number		Page
Table III-I	Fabric Filter System Design Parameters	5
Table IV-I	Dry Gas Volume Computer Program	69
Table IV-II	Program For Method 7 Calibrations	78
Table IV-III	Suggested Performance Criteria for Particulate Sampling Equipment	83
Table IV-IV	Suggested Performance Criteria for SO_2 Sampling Equipment	84
Table IV-V	Suggested Performance Criteria for NO_x Sampling Equipment	85
Table V-I	Phase I Test Results	89
Table V-II	Phase II Test Results	92
Table V-III	Phase III Test Results	94
Table V-IV	Phase IV Test Results	95
Table V-V	Results of SPS/GCA Joint Test	97

CONVERSION TABLE

To Convert From	To	Multiply by
BTU/lb	joules/kg	4186.8
°F	°C	(°F-32)/1.8
°F	°K	(°F-32).56
ft	m	0.305
gr/scf	gm/m^3	2.29
in.	cm	2.54
in w.g.	mm Hg	1.87
lb	gm	454
miles	km	1.609
oz.	grams	28.350
ppm	mg/liter	1.0
Btu	joules	1055
cfm	cubic meters/hr	1.699
ft/sec	centimeters/sec	30.48
sq. ft.	sq. meters	0.093
lbs. of tension	newtons	4.448
stack pressure in Hg	kg/cm^2	0.035
$wscf/10^6$ Btu	wscm/joule	2.6×10^{-11}
$lbs/10^6$	nanogram/joule	433.3
lbs/wscf	$micrograms/m^3$	16.018×10^8
ft^2	$meters^2$	0.093

I. INTRODUCTION AND BACKGROUND

Electric utilities, in recent years, have begun a search for the most efficient, economical method of emission control to use in association with boilers designed to burn low sulfur coal. One promising application is fabric filtering. Fabric filters have been used successfully by other industries for particulate capture. Southwestern Public Service Company (SPS), an electric utility based in Amarillo, Texas, first began considering baghouses for utility application in the mid-1970's after having installed a precipitator/wet scrubber on the company's first coal-fired unit. SPS compared costs, operating and maintenance parameters, and visited the only two utility baghouses in operation at that time (Nucla Station and Sunbury Station). Based on this limited information, SPS selected a fabric filter system to be used for emission control on its second coal-fired unit.

The SPS baghouse was the first to be installed on a new utility boiler firing low sulfur Western coal; therefore, its operation and performance was of special interest to the U. S. Environmental Protection Agency (EPA). In 1977, the EPA executed a contract with SPS to conduct an in-depth study of this new emission control alternative. The objective of the five-year program is to fully characterize the performance of a large utility baghouse controlling emissions from a boiler firing low sulfur Western coal.

One of the major aims of the SPS/EPA study is to determine mass emissions of particulate, sulfur dioxides, and oxides of nitrogen. The contract specifies a special testing program designed to measure these parameters and relate results to the collection efficiency of the fabric filter system.

The original work plan called for three special tests by SPS. However, the test dates were altered in order to allow for changes in operating conditions and budget limitations. Tests were conducted by SPS at the following times:

Phase I	December	11-15, 1978
Phase II	October	8-12, 1979
Phase III	March	24-25, 1980
Phase IV	August	26-29, 1980

The contract also called for three more specialized tests to be conducted by an outside consultant under subcontract to Southwestern. GCA Corporation was selected to sample simultaneously at five locations for the following parameters: particulate, C_7 - C_{17} organic compounds, C_1 - C_6 organic compounds, CO_2, O_2, CO, SO_2, SO_3, NO_x, and particle size distribution. GCA conducted their first test in February 1979. Results from this test led SPS and the EPA to a decision to reduce this phase of the test program to only one more test to be performed as a joint test by SPS and GCA. Furthermore, the test parameters were reduced to the following: particle size distribution by three methods, and SO_2 and SO_3 sampling at three locations. This series of tests was performed in June, 1980. Results of the GCA tests will be reported in a separate report.

Even though it was the intent of SPS to accomplish the objectives of the tasks set forth in the contract, several problems were experienced during initial operation of the baghouse which kept it from being classified as a typical or standard type of air quality control device.

These problems centered around the control of the cleaning cycle, control of the deflation pressure during the cleaning cycle, proper tension on the bags when they were first installed, a higher than normal bag failure rate, and indications that Harrington Station's fly ash had some unique characteristics which made predicting proper design difficult. Programs were developed to investigate these problems and to attempt to find solutions.

II. CONCLUSIONS

The sampling conducted by Southwestern Public Service Company on Harrington Station Unit 2 was conducted in four phases. The first phase conducted in December 1978, verified that NO_x emissions, as measured by EPA Method 7, were not significantly affected by the fabric filter system. The unit operated below the applicable New Source Performance Standard (NSPS) of 0.7 lb/10^6 Btu at a level of approximately 0.64 lb/10^6 Btu. The concentrations of NO_x were tested simultaneously at two inlet, two outlet and one stack location. Since the NO_x emissions were determined to be less than the NSPS and stack emissions were close to the inlet emissions, it was concluded that no significant removal efficiencies were occurring within the fabric filter system. Therefore, the sampling for oxides of nitrogen was discontinued after the first test.

Sulfur dioxide emissions were determined by EPA Method 6 four times during the test program. Stack emissions of SO_2 agreed very well with the theoretical SO_2 emission. The unit operated consistently below the NSPS of 1.2 lb/10^6 Btu at a level of approximately 0.8 lb/10^6 Btu. Based upon the observed inlet and stack concentration there was no appreciable absorption of SO_2 on the filter cake during filtering.

Particulate emissions were actually determined by EPA Method 5 five times during the test program. The unit was tested during October 1979, with fabric that was approximately 3 months old. This test gave the lowest average emission of 0.020 lb/10^6 Btu. Tests conducted later averaged an emission rate of 0.028 lb/10^6 Btu with extreme emission rates of 0.016 to 0.044 lb/10^6 Btu.

Tests conducted during the fabric filter study indicate that Harrington Station, using low sulfur and low ash Western coal, can consistently operate within all applicable mass emission rates while using a fabric filter system for air quality control.

III. HARRINGTON STATION DESCRIPTION

Harrington Station, located approximately five miles northeast of Amarillo, Texas, is owned and operated by SPS. The facility consists of three 360 MW pulverized, coal-fired boilers. Unit 1 is equipped with an electrostatic precipitator followed by a marble bed wet scrubber. Units 2 and 3 are each equipped with a fabric filter system.

The Unit 2 steam turbine is a Westinghouse designed, single reheat, tandem compound, double flow turbine with 28.5-inch last stage blades. The steam turbine drives a 400 MVA electric generator.

The steam boiler is a Combustion Engineering steam generator, tangentially fired, capable of producing 2,682,383 pounds of steam per hour at 2500 psig, 1005° F superheat, and 1005° F reheat. The basic fuel source for Harrington is pulverized Western coal, but the steam generator furnace is also designed for alternate fuels (natural gas and No. 2 burner fuel oil).

Coal is delivered to Harrington by rail from an Atlantic Richfield Company mine in Campbell County, Wyoming. Average parameters of the coal are 8,475 Btu/lb, 0.3% sulfur, and 5.5% ash. (A representative coal analysis for each test phase is shown in Appendix A.) Coal is fed with automatic equipment into coal mills where it is crushed to approximately 200 mesh. This fine coal dust is blown into the boiler furnace with high temperature air where combustion takes place.

The emission control device selected for Unit 2 is a Wheelabrator-Frye, Inc. fabric filter baghouse system. The baghouse is designed to operate at a flue gas flow of 1,650,000 acfm at 313° F. Minimum design efficiency is 98.6%, which would permit 0.1 lbs. of particulate/million Btu out the stack. The exterior of the baghouse has 3.5 inches of fiberglass insulation; there is no insulation between plenums and compartments.

The baghouse is equipped with bypass dampers for start-up, emergency operation, and shut-down. Other design parameters are summarized in Table III-1.

There are two baghouses on Harrington Unit 2, one designated east and one designated west. Each one has its own operating control system and all bypass dampers are separated for each system.

Bag cleaning is accomplished by a deflate/shake cycle. During the normal filtering sequence the outlet and the reinflation dampers are open, while the deflation damper is closed. During the cleaning cycle the reinflation damper and outlet damper is closed, leaving the inlet damper open. After an initial settle period, the deflation damper opens, which provides just enough reverse air to gently collapse the bags, causing the filter cake to fracture. The cake is then separated from the fabric by mechanical shaking. After a final settle period the reinflation and outlet dampers open, putting the compartment back in service.

The Unit 2 baghouse has four cleaning cycle modes which were designed to provide maximum flexibility of operation. Mode 1 will clean the west baghouse and then the control system will reset; Mode 2 will clean the east baghouse and reset; Mode 3 will clean compartments 1 through 28 before the system is reset; and Mode 4 will clean the east and west baghouses simultaneously, one compartment at a time on each baghouse.

Table III-1. Fabric Filter System Design Parameters

Compartments	28
Bags per Compartment	204
Model	No. 366, Series 11.5 RS Dustube
Bag Diameter	11.5 inches
Bag Length	30 feet, 8 inches
Bag Spacing, Center to Center	14.0 inches
Design Air-to-Cloth Ratio, Gross	3.16:1
with 1 compartment down	3.27:1
with 2 compartments down	3.40:1
Bag Reach	2
Cleaning Mode	Deflate/Shake
Total Cloth Area	5.14×10^5 ft^2
Bag Design	Caps with eye bolts
Original Fabric	Criswell fiberglass, silicone/graphite coating

SPS brought the Harrington Station Unit 2 baghouse into service on June 21, 1978. Approximately three weeks after the baghouse was initially started, SPS was able to operate Unit 2 at full load with only coal in service. The unit has operated at loads consistently above 200 Mw and during peak periods, it has handled loads of 367 Mw.

Since start-up, a variety of adjustments have been made, including a complete change-out of the bags. Shaker mechanisms have been re-worked and timing sequences have been altered. These changes took place at different periods in the special testing program. They will be discussed in more detail and their relationship to a particular phase of testing more specifically defined in Section V of this report. For a more detailed overview of the Harrington Station baghouse performance, refer to the first and second annual reports (1, 2).

IV. EQUIPMENT, METHODS, CALIBRATION PROCEDURES

A. Introduction

The procedures described in this section were implemented by the Environmental Group of the System Laboratory for collection, recovery, and analysis of samples for the determination of particulate, SO_2, NO_x, and combustion gases (O_2 and CO_2) in flue gases during special test periods. Also discussed are methods for fabrication of equipment, calibration procedures, and the quality control/quality assurance procedures employed by SPS for the special testing program. Samples of raw field data are included in Appendix B.

This section of the special testing report will be somewhat familiar to those experienced in stack sampling. The procedures are basically the same as EPA Methods 3, 5, 6, and 7 as outlined in the Federal Register.

B. Fabrication of Equipment

1. Sampling Consoles: The SPS sampling team utilized five sampling consoles during the test program. Three of the consoles were purchased from Lear Siegler and the general specifications of these consoles are given in Figure IV-1. The two remaining consoles were fabricated by System Lab personnel and are similar in design to standard EPA approved consoles except that the vacuum pumps are located externally. The pumps are plumbed according to the drawing in Figure IV-2.

2. Probes and Probe Liners: The System Lab has six probes with steel liners. Four of these are for baghouse testing and have 316 stainless steel liners. The liners are 1/2-inch outside diameter (O.D.). Two of the probes are 22 feet long (inlet) and two are 32 feet long (outlet). The other two probes are for stack testing. They have 5/8-inch O.D. Inconel liners. The probe used for the special testing program is 12 feet long. Drawings showing the assembly of the probes are included here in Figures IV-3 and IV-4.

The probe liners have an 18/9 male ball joint on one end. The liners are wrapped twice with fiberglass tape, then electrically insulated 25 gauge nichrome wire is spiraled the length of the probe and two more layers of fiberglass tape wrapped over that. On the stack probes, one 50-foot piece of nichrome wire is used. The two 22-foot probes have two 50-foot sections of nichrome wire connected in parallel. The two 32-foot probes have two 25-foot sections and one 50-foot section of wire connected in parallel. Figure IV-5 shows the method of wrapping the nichrome wire. A ground wire is attached to each probe liner to prevent electrical shock in case of a short. The hook-up wire used is 16 gauge, Teflon-insulated hook-up wire. The pitot tube lines and thermocouple casing (copper tubing) are attached to the probes in the manner shown in Figure IV-6.

3. Type S Pitot Tubes: The type S pitot tubes used for special testing are constructed out of 1/4-inch O.D. stainless steel according to the specifications given in the Federal Register of August 4, 1978. They are approximately 18 inches long and have Swagelok fittings for attachment to the pitot tube lines. A drawing of these tubes can be found in Figure IV-7.

4. Umbilical Cord: Figure IV-8 is an end view of the umbilical cord used on the stack. The pitot tube lines are 1/4-inch inside diam-

SAMPLING CONTROL UNIT
LEAR SIEGLER CONSOLE

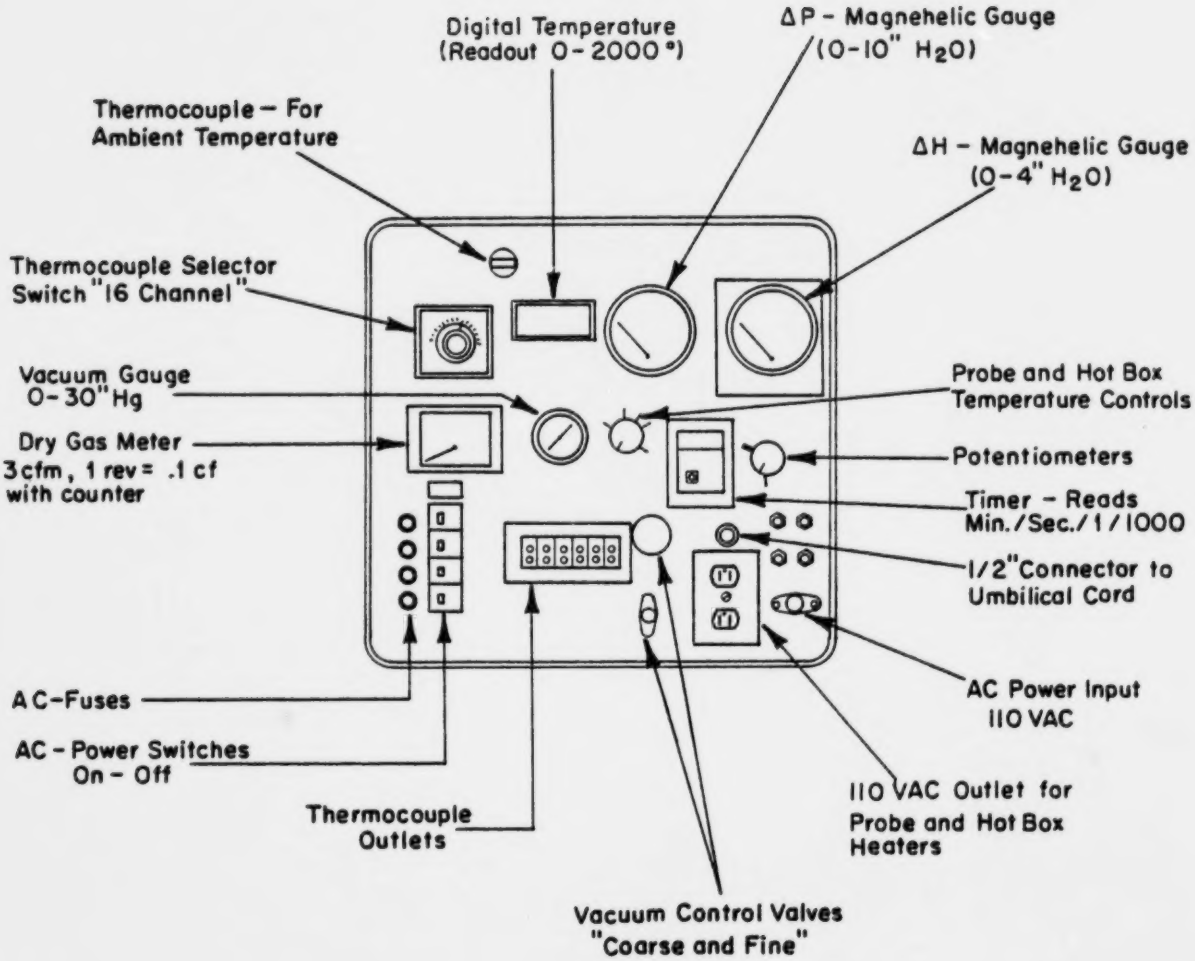


FIGURE IV-1. LEAR SIEGLER CONSOLE

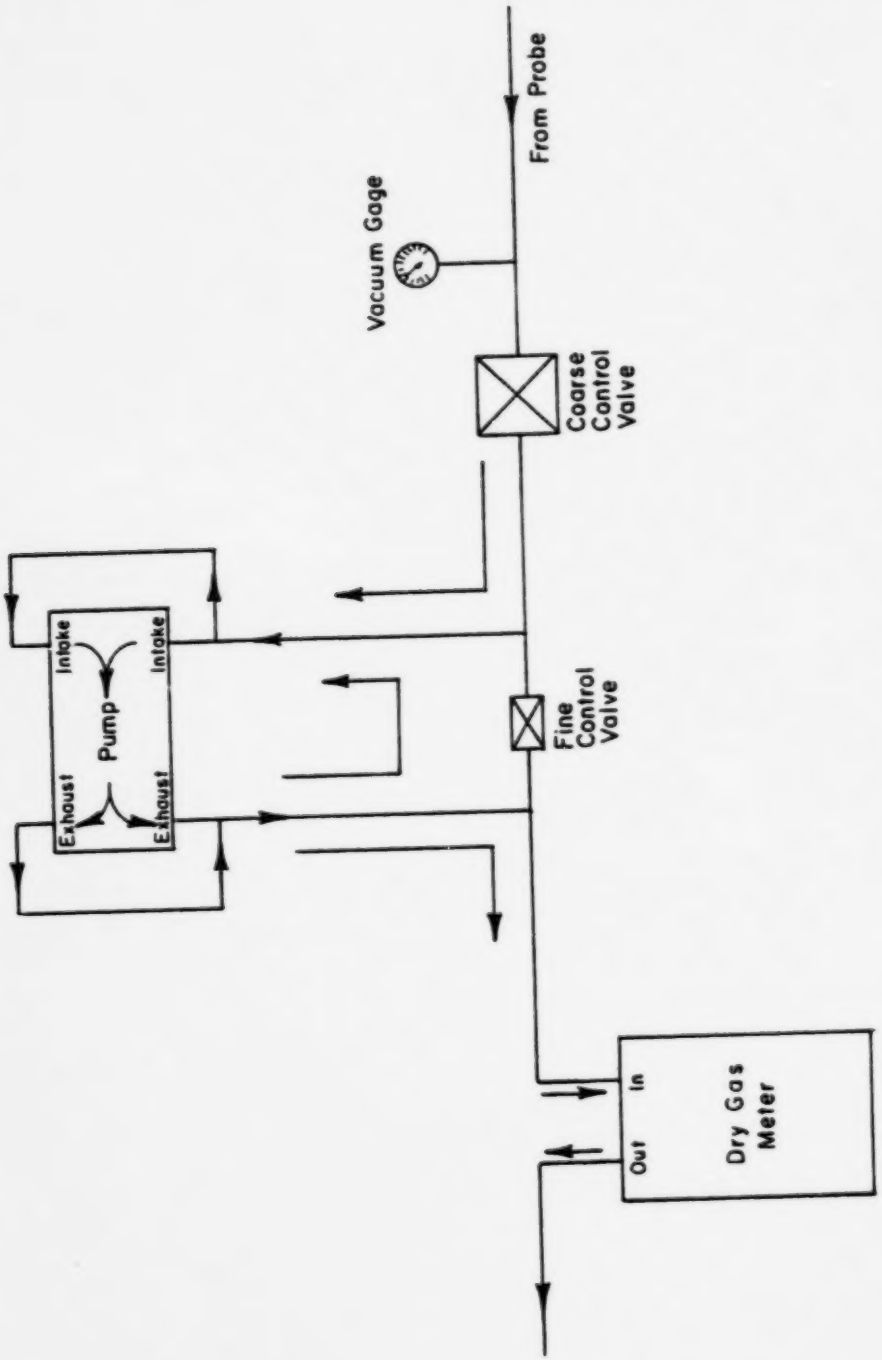
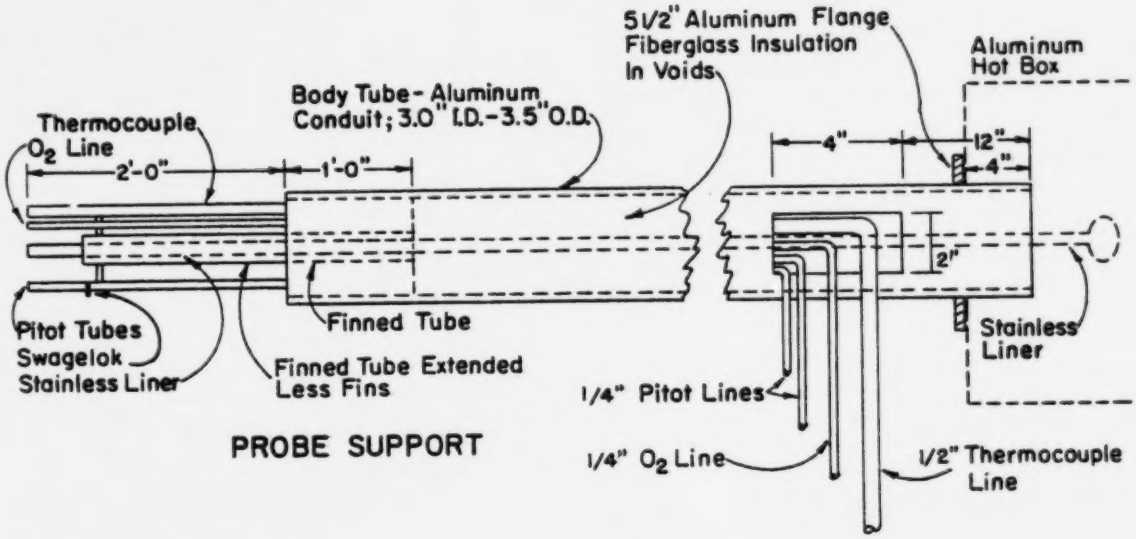
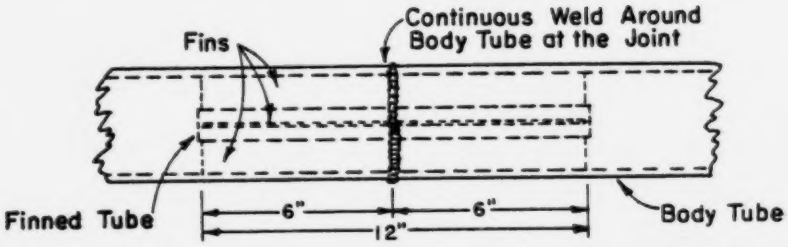


FIGURE IV-2. PUMP FLOW DIAGRAM



PROBE SUPPORT

2 - 22 Foot Probes
2 - 32 Foot Probes



TYPICAL JOINT DETAIL

Note: Fins continuously welded to finned tube, spot welded to body tube at end of fins.

FIGURE IV-3. MANUAL SAMPLING PROBE

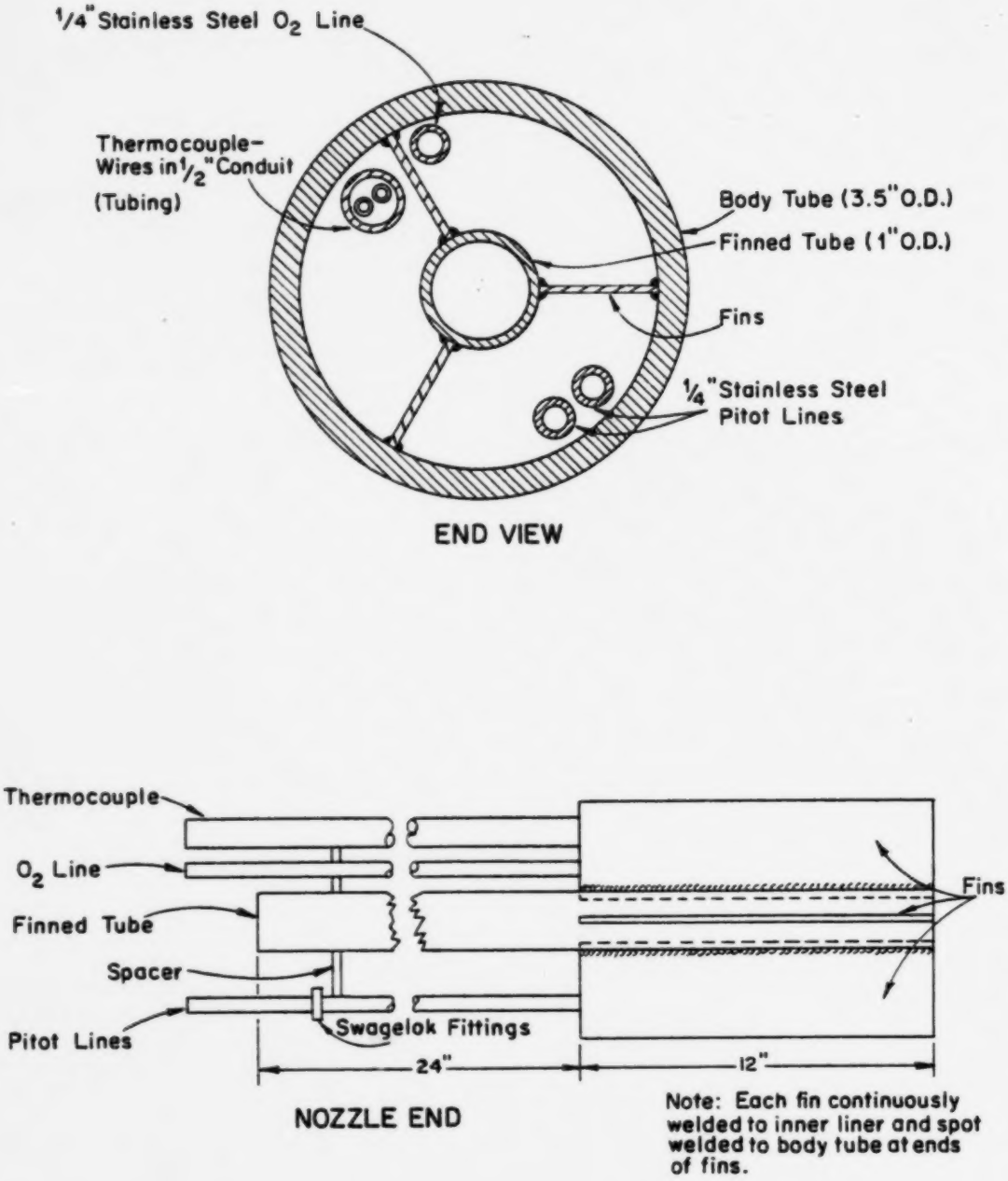


FIGURE IV-4. PROBE LINER SUPPORTS

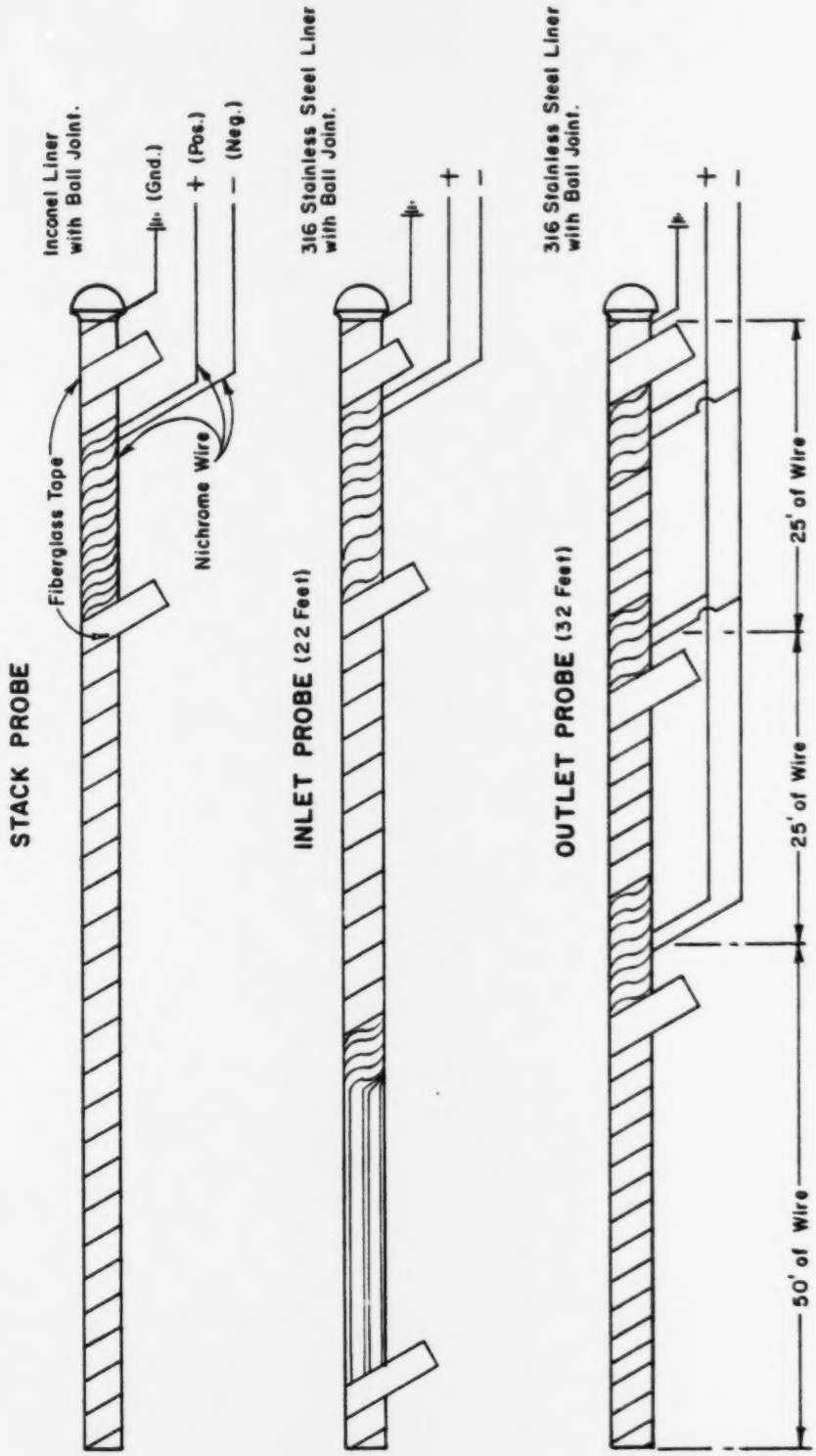


FIGURE IV-5. METHOD OF WRAPPING NICHROME WIRE

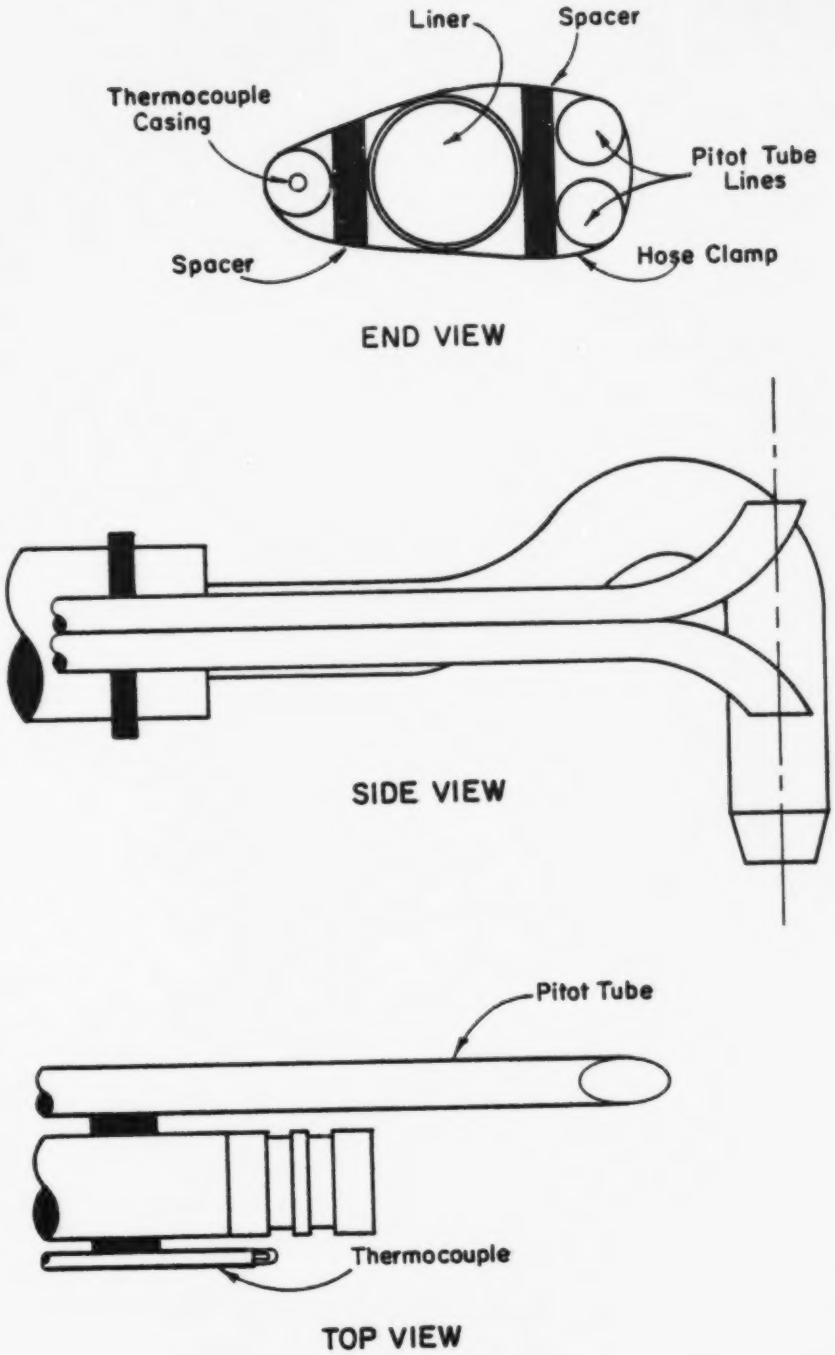


FIGURE IV-6. ATTACHMENT OF PITOT TUBE LINES AND THERMOCOUPLE CASING

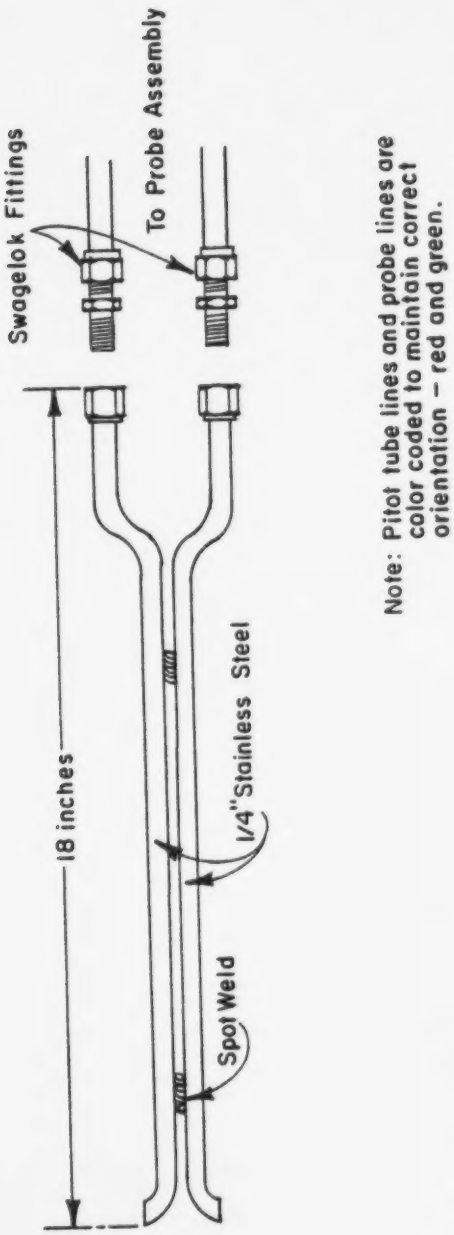


FIGURE IV-7. TYPE S PITOT TUBES

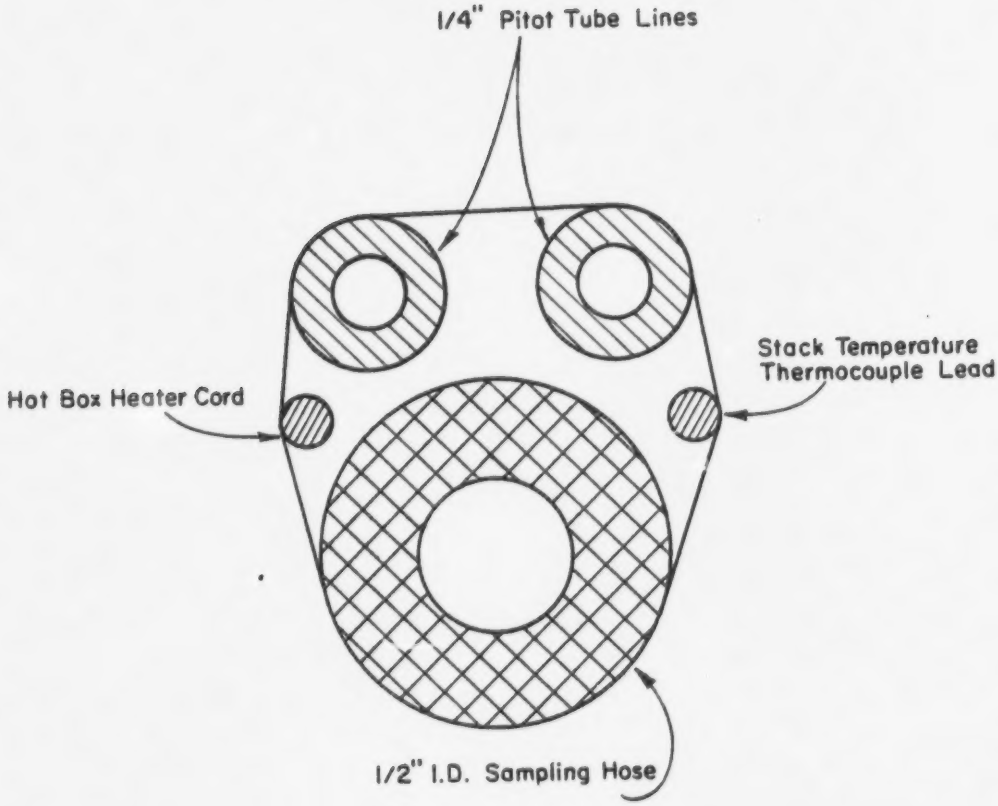


FIGURE IV-8. UMBILICAL CORD

eter (I.D.) welding tubing. The sampling hose is 1/2-inch I.D. thick-wall Tygon tubing. These are taped together at about 1-foot intervals with black electrical tape. The pitot tube lines have 1/4-inch O.D. stainless steel tubing inserted in the end that goes to the sampling console and Tygon tubing attached to make connection to the console magnehelics easier. All tubing to hose connections are made fast with hose clamps.

5. Probe Extensions: The extensions of the probe from the hot box to the cold box for vertical sampling is Teflon, high-temperature heated hose. The hose has a built-in electric heating element that can provide uniform heat up to 450° F. throughout the entire length of the hose. The core is made of 1/2-inch I.D. Teflon. The hose has half an inch of thermal insulation. A drawing of this probe extension can be found in Figure IV-9. A drawing of a complete vertical sampling set-up and a complete stack sampling set-up can be found in Figures V-10 and IV-11.

C. Calibration Procedures

1. Calibration of Standard NO_x Volume Flask: The standard volume flasks were calibrated for special testing by filling the flask to the mark with D.I. water and then weighing the water to the nearest gram. The temperature of the water and the density of water at that temperature was also recorded. (See Figure IV-12, Form for Calibration of Standard Volume Flasks.) This procedure was repeated three times. The ml of water used was determined by the following formula:

$$(xg)\ \frac{(1)}{e} = ml \qquad (1)$$

where

xg = weight of water used to the nearest gram

e = density of water at a given temperature.

This volume was then converted to cubic feet using the following formula:

$$ml \times \frac{ft^3}{28{,}316\ ml} = ft^3 \qquad (2)$$

where
ml = ml of water as determined above
28,316 = #ml/ft^3.

The three values were averaged and that value assigned to the flask as the standard volume when filled to the mark.

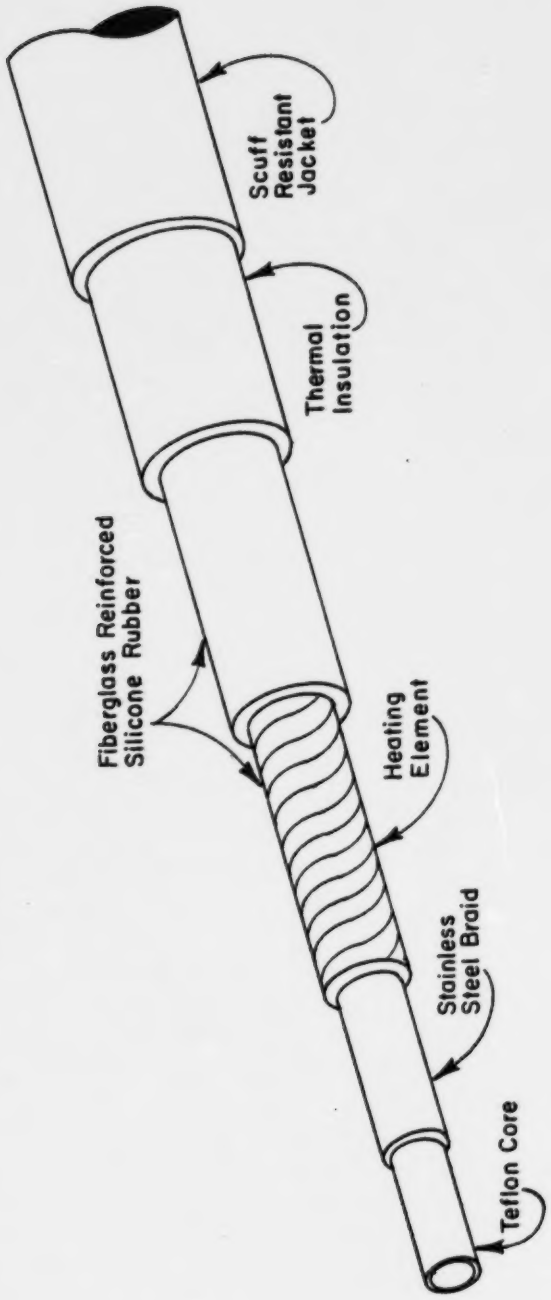


FIGURE IV-9. PROBE EXTENSION

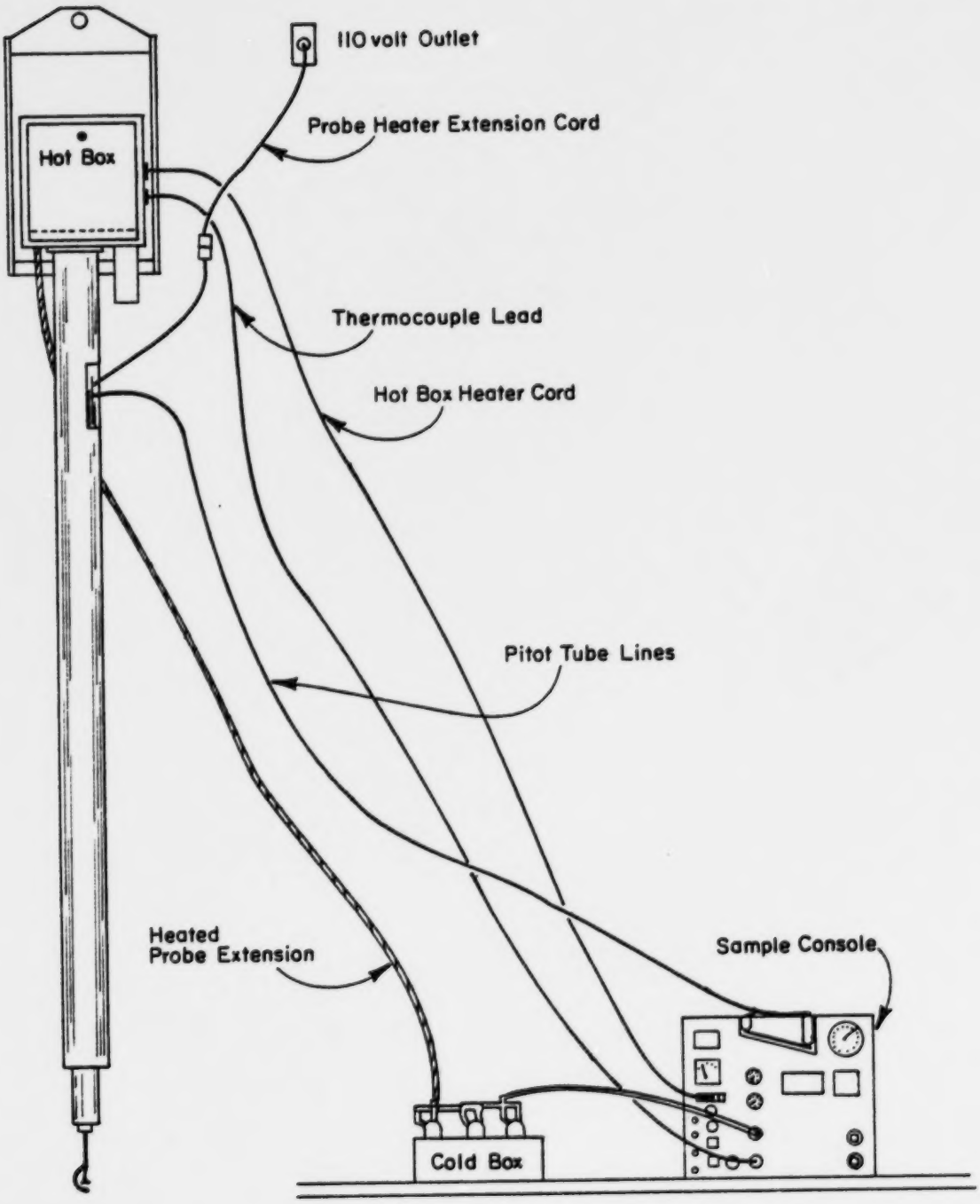


FIGURE IV-10. VERTICAL SAMPLING SET-UP

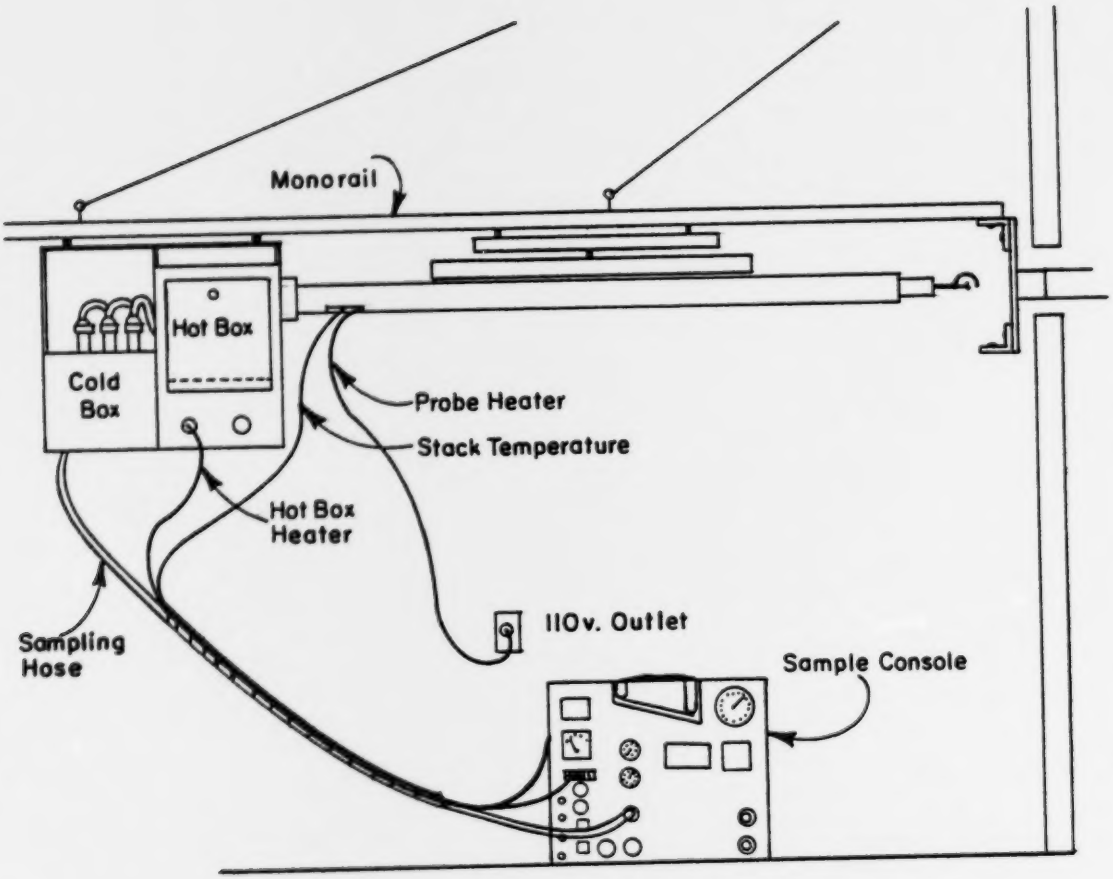


FIGURE IV-11. STACK SAMPLING SET-UP

Calibration of Standard Volume Flasks

Flask #_____

Date_____

	Weight of Water	Temperature	Density (e) at Given Temperature
Run #1			
Run #2			
Run #3			

$$(xg)\left(\frac{1}{e}\right) = ml$$

$$ml \times \frac{ft^3}{28{,}316\ ml} = ft^3$$

Standard ft^3

Run #1

Run #2

Run #3_____

Avg.

Figure IV-12. Form for Calibration of Standard Volume Flasks

2. Calibration of Wet Test Meter: The wet test meters were calibrated during the test program by passing a known volume of saturated gas through them. To do this, air was displaced by a known volume of water in a leak-free system through the wet test meter.

A 46-liter flask was used to displace the air into the wet test meter. The exact volume of air that was displaced was determined by calibration of the flask. The flask and wet test meter were hooked up as shown in Figure IV-13. The water level in the wet test meter was correct and the initial wet test meter reading recorded. (See Figure IV-14, Form for Wet Test Meter Calibration.) D.I. water was used to displace the air. The water was added to the flask at a fairly constant rate. The level of water was stopped exactly on the mark that is shown on the flask. After filling the flask, the final wet test meter reading was recorded. The difference in the final and initial readings was calculated. The wet test meter correction factor was calculated using the following formula:

$$\text{Wet Test Meter Correction Factor} = \frac{\text{standard volume}}{\text{volume measured by wet test meter}} \quad (3)$$

The value obtained and the date was put on a label and placed on the wet test meter.

3. Calibration of Dry Gas Meters: The calibration of the dry gas meter (DGM) was done by making simultaneous total volume measurements with a calibrated wet test meter and the dry gas meter. The complete sampling console system was leak checked before the calibration was done. For metering systems with diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump.

To do the pre-calibration leak check, the sampling console and wet test meter were hooked up as shown in Figure IV-15. The wet test meter (WTM) was leveled and the outlet of the WTM connected to the inlet line of the console. The outlet of the bubbler was connected to the WTM inlet. A 10-minute calibration run was done at a rate of 0.02 cfm. The initial wet test meter and dry gas meter readings were taken as were the final readings at the end of the run. The following formula was used to calculate the leak rate:

$$\frac{\text{Vol. Measured by Wet Test Meter-Vol. Measured by Dry Gas Meter}}{10} \quad (4)$$

This value must be less than 0.02 cfm.

After a good pre-calibration leak check was obtained, the calibration of the dry gas meter was continued. Set-up for calibration was the same as for the leak check procedure. The sampling pump was turned on and allowed to warm up for a few minutes. The pump was valved off and the initial DGM and WTM readings were taken. The pump was then valved on and the rate adjusted to about 0.2 cfm and the vacuum to about 10 inches of Hg. The initial ambient inlet to DGM and outlet to DGM temperatures were also recorded.

The pump was allowed to run until 10 (or more) cubic feet had passed through the dry gas meter. Temperature readings were taken right before stopping the pump, then the pump was stopped and meter readings were recorded. The calibration factor was determined by using the following formula:

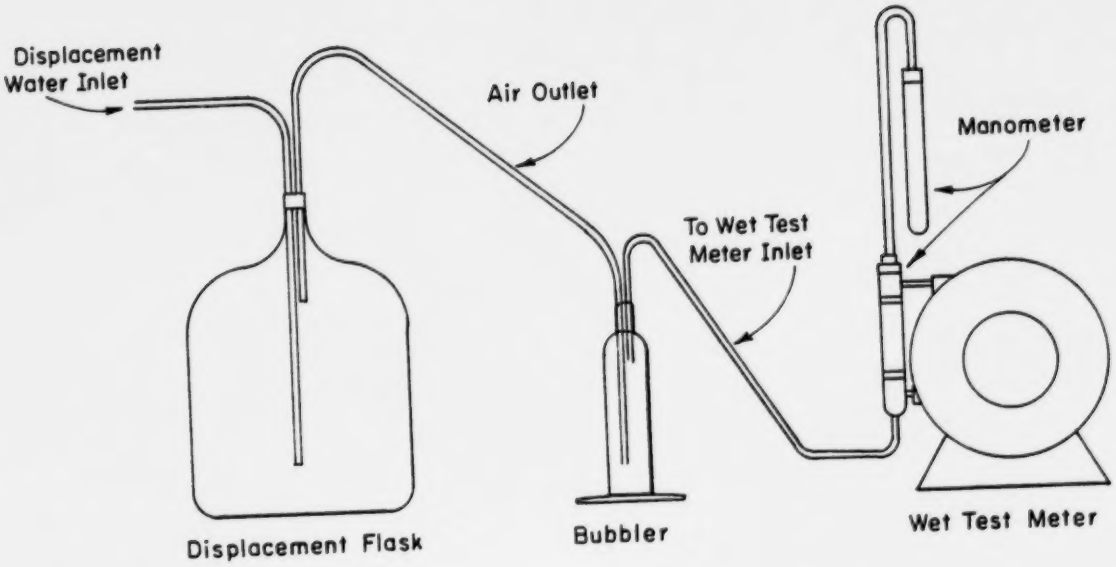


FIGURE IV-13. FLASK AND WET TEST METER HOOK-UP

Wet Test Meter Calibration

Wet Test Meter No._____

Date_____

Run No._____

Calibrated by_____

Standard Flask No._____

Standard $ft.^3$_____

Wet Test Meter Reading Final_____

Wet Test Meter Reading Start_____

Wet Test Meter Reading Difference (WTMRD)_____$ft.^3$

Wet Test Correction Factor = $\frac{\text{Standard}}{\text{WTMRD}}$ = _____

Figure IV-14. Form for Wet Test Meter Calibration

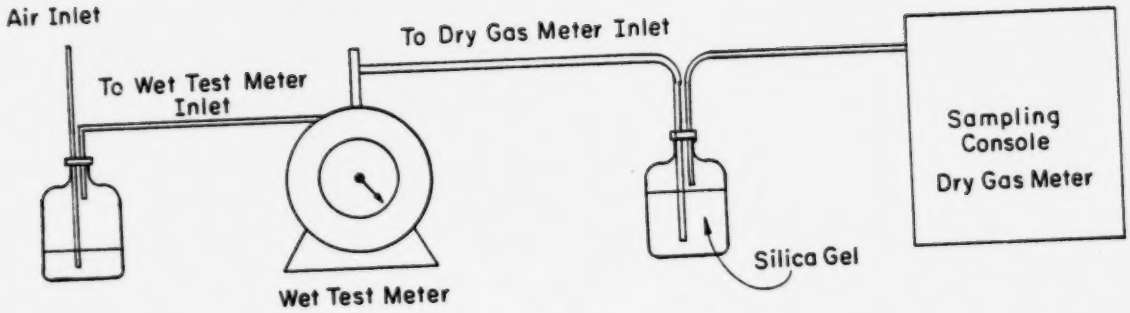


FIGURE IV-15. SAMPLING CONSOLE AND WET TEST METER HOOK-UP

$$DGM = \frac{(WTD)\ (P\ Bar \times \frac{\Delta H}{13.6})\ (WF)\ (Tm + 460)}{(DFG-DGI)\ DGI(P\ Bar + \frac{\Delta P}{13.6}\ (Ta + 460)} \qquad (5)$$

where
WTD = wet test meter difference
WF = wet test meter correction factor
DGF = final DGM reading
DGI = initial DGM reading
Ta = average wet test meter temperature
Tm = average dry gas meter temperature
ΔH = inches of water across DGM orifice
ΔP = inches of water across wet test meter.

This procedure was repeated three times and the average of the three runs assigned as the correction factor of the DGM. The date of calibration and the correction factor was put on a label and placed on the sampling console. (See Figure IV-16, Form for Pre-Calibration Leak Check and Figure IV-17, Dry Gas Meter Calibration Form.)

4. Orifice Calibration: The orifice was calibrated by passing various known flow rates through it and recording the pressure differential between upstream and downstream taps on the Orifice Calibration Form (Figure IV-18).

The procedure for the actual calibration was as follows: The barometric pressure and the dry gas meter correction factor was recorded on the data sheet. The pump was turned on and the vacuum adjusted to 10 inches Hg and the delta H to 0.2 inches of H_2O. Initial entrance and exit temperatures of the DGM were recorded. The length of time in seconds required for one cubic foot of air to pass through the DGM was measured. This number and the final entrance and exit temperature were recorded. The above procedure was repeated for each 0.2 increment of delta H up to 3.0 inches, and then for every 0.5 increment.

The flow rate for each increment in standard cubic feet per minute (SCFM) was calculated using the following equations:

$$Vol\ in\ ACFM = \frac{DG_f - DG_i}{time} \times 60 \qquad (6)$$

$$Vol\ in\ SCFM = (Vol\ in\ ACFM)\ (DGMCF)\ \left(\frac{530}{T+460}\right)\left(\frac{Bar.\ Pressure}{29.92}\right) \qquad (7)$$

Pre-Calibration Leak Check

Console#_____

Date_____

Checked by_____

Final Wet Test Meter Reading_____

Initial Wet Test Meter Reading_____

Wet Test Meter Difference (WTMD)_____

Final Dry Gas Meter Reading_____

Initial Dry Gas Meter Reading_____

Dry Gas Meter Difference (DGMD)_____

$\frac{\text{WTMD - DGMD}}{10}$ must be 0.02 DVM

Figure IV-16. Form for Pre-Calibration Leak Check

Dry Gas Meter Calibration Form III

By Wet Test Meter

Run #_____

Date_____ ΔP = _____ IN. H_2O

Control Terminal_____ ΔH = _____ IN. H_2O

Purpose_____ P_{bar} = _____ IN. Hg.

Calibrated_____ Ambient _____ °F

Wet Test Meter, Final (WTMF) _____ cf

Wet Test Meter, Initial (WTMI) _____ cf

WTD = (WTMF-WTMI) _____ cf

Calibration Factor For Wet Test Meter (WF) _____

Date of Last Calibration For Wet Test Meter _____

Temperatures		Wet Test Meter		Dry Gas Meter Inlet	Dry Gas Meter Outlet
Initial		_____		_____	_____
Final		_____		_____	_____
Sum	2÷	_____		_____	_____
Average WTM		_____	°F		+ _____
Temp(T_a)		_____	°R		
					4÷ _____ °F
					_____ °F

Average Dry Gas Meter Temp (T_m) _____ °R

Dry Gas Reading, Final (DGF) _____ cf

Dry Gas Reading, Initial (DGI) _____ cf

(DG-DGI) = DF _____ cf

Dry Gas Meter Factor (DF) = _____ _____

$$\frac{WTD(P + \frac{\Delta H}{13.6})(WF)(T_m)}{DF(P + 13.6)(T_a)} =$$

( ) (+ $\overline{13.6}$)(×) = _____

( ) (+ $\overline{13.6}$)( )

Figure IV-17. Dry Gas Meter Calibration Forms

ORIFICE CALIBRATION

Date_____ Calibrated By_____

Dry Gas Meter Correction Factor_____ Barometric Pressure_____

in H_2O (ΔH)	DG_i (ft^3)	DG_f (ft^3)	T_{in_i} (°F)	T_{out_i} (°F)	T_{in_f} (°F)	T_{out_f} (°F)	$\bar{T}$ (°F)	$\bar{T}$ (°R)	Time SEC	ACFM	SCFM

$$\text{Vol in ACFM} = \frac{DG_f - DG_i}{\text{Time}} \times 60$$

FIGURE IV-18. ORIFICE CALIBRATION FORM

$$\text{Vol in SCFM} = (\text{Vol in ACFM})\,(\text{DGMCF})\left(\frac{530}{\bar{T} + 460}\right)\left(\frac{\text{Bar. Pressure}}{29.92}\right)$$

where

ACFM = actual cubic feet per minute
SCFM = standard cubic feet per minute
DG_f = final dry gas meter cubic feet
DG_i = initial dry gas meter cubic feet
DGMCF = dry gas meter correction factor
T = average meter temperature.

5. Standardization of Thermometers: Dial-type thermometers are calibrated using in-glass mercury thermometers that had been certified. At least three points were used to check the thermometers. (These are the freezing and boiling points of water and room temperature.) The standard thermometer number, standard thermometer reading, and each thermometer reading was recorded on the data sheet. (Figure IV-19, Form for Standardization of Thermometers.) The dial type thermometers must agree to within $\pm$ 1.5 percent of the standard value.

6. Calibration of Magnehelic Gauges: The procedure for calibrating magnehelic gauges involved comparison of value for pressure differentials on the magnehelic and an inclined manometer. The magnehelic is tied in parallel with an inclined manometer as shown in Figure IV-20. The impact side of the manometer was attached to the intake side of the orifice and the static side to the exhaust side of the orifice. The pump was started with the coarse valve open and the manometer disconnected. The coarse valve was then closed and the manometer connected. The valve was then opened slowly and the delta H as measured by the manometer was compared with that of the magnehelic. The flow was adjusted to give delta H readings in 0.5 inch increments through the range of the magnehelic.

Standardization of Thermometers

Date: _____

Standard #	Standard Reading					

Figure IV-19. Form for Standardization of Thermometers

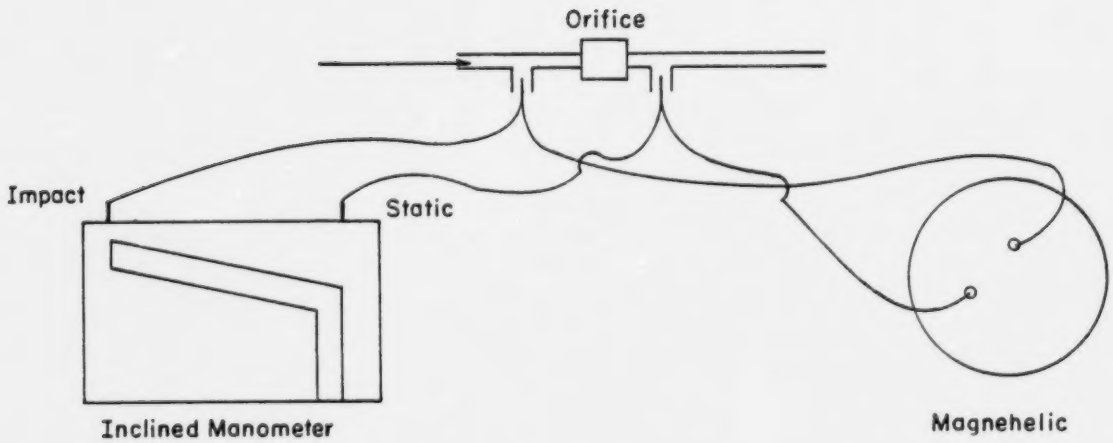


FIGURE IV-20. MAGNEHELIC CONNECTION TO INCLINED MANOMETER

If delta P magnehelics were being calibrated, tubes were attached to the suction or pressure of the magnehelic and either blown or sucked on the line and clamped off. The magnehelic must agree to within at least 5 percent of what the manometer reads. Figure IV-21 is the form for recording magnehelic calibrations.

7. Probe Heater Checks: The probe heaters were checked by measuring the internal temperature of the probe liner as a function of time. To do this, a piece of thermocouple wire long enough to reach about the middle of the probe was crimped at the ends and inserted in the liner. The temperature was recorded every minute or so until the rate of increase slowed. Then it was recorded about every 10 minutes until the maximum temperature was reached. (See Figure IV-22, Probe Heater Check Form.)

8. Calibration of Pitot Tubes: If pitot tubes could not be calibrated in a wind tunnel, the following procedure was used for calibration. The stack on Nichols Station Unit 3, located one mile from Harrington Station, was used to provide the flow for calibration. The type S pitot tubes were calibrated against a standard pitot tube. Two inclined manometers were used for the calibration. The manometers were leveled and zeroed. Each pitot tube was then hooked up to a manometer and both systems were leak checked. After good leak checks were obtained, the two tubes were inserted into the stack and aligned in the same plane. The delta P, as measured by each pitot tube, was recorded (Figure IV-23, Pitot Tube Calibration Form). The two tubes were then moved to another position in the stack and the readings taken again. This procedure was conducted at least three times. The type S pitot tube was then rotated and the procedure repeated for the other side of the tube. The pitot tube coefficient was calculated using the formula below:

$$Cp = Cp(std) \frac{p\ std}{p} \qquad (8)$$

where

Cp = Type S pitot tube coefficient

Cp = Standard pitot tube coefficient (use 0.99 if not known)

p std = velocity head measured by the standard pitot tube

p = velocity head measured by the type S pitot tube.

This calculation was done for each of the three runs on each side of the pitot tube. The average of the three runs is the pitot tube coefficient assigned to the tube for that side.

Magnehelic Calibration

Console #_____

Date_____

Calibration done by_____

Manometer Reading	Magnehelic Reading

Figure IV-21. Form for Magnehelic Calibration

Probe Heater Check

Date: _____

Probe #_____

Time	Probe Internal Temperature
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Checked by:_____

Figure IV-22. Probe Heater Check Form

PITOT TUBE CALIBRATION

(using a wind tunnel)

PITOT TUBE NUMBER_____ DATE_____

CALIBRATED BY_____

STANDARD PITOT TUBE NUMBER_____

STANDARD PITOT TUBE CALIBRATION FACTOR_____

WIND TUNNEL FLOW	STANDARD PITOT TUBE TUBE ΔP in inches H_2O	"S" TYPE PITOT TUBE in inches H_2O	C_p "S" TYPE CALIBRATION FACTOR
0.3" H_2O			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			
1.0			
1.5			
2.0			

$$C_p = C_{pstd} \left(\frac{\Delta P \text{ STANDARD}}{\Delta P \text{ "S" TYPE}} \right)^{\frac{1}{2}}$$

$$C_{p\ avg.} \overset{*}{=} \frac{\sum C_p}{n} \qquad C_{p\ avg.} = \frac{\quad}{10}$$

$C_{p\ avg.}$ = _____

C = "S" Type Calibration Factor.

$C_{pstd.}$ = Standard Pitot Tube Calibration Factor.

$C_{pavg.}$ = Average "S" Type Calibration Factors.

FIGURE IV-23. PITOT TUBE CALIBRATION FORM

SPS Environmental Date 5-19-80

For the coefficient factor to be acceptable, the average deviation of the three run values must be 0.01 and the absolute value of the difference of the two sides must be 0.01. The calculation of the average deviation is as follows:

$$\text{average deviation} = \sum_{1}^{3} \frac{Cp - \bar{C}p}{3} \qquad (9)$$

where

Cp = the type S tube coefficient for a given run and given side

$\bar{C}p$ = the average tube coefficient.

D. Collection and Analysis For Combustion Gas

The gas analysis apparatus used in the special test program for gas analysis, (i.e., O_2 and CO_2), is a Burrell standard Orsat analyzer. The Orsat bags used to collect the gas sample are 5-liter, "snout" type, constructed of layers of polyester, polyvinyl chloride, aluminum foil, polymide, and polyethylene. The probe used to sample is 1/4-inch stainless steel and the pump used is a one-way squeeze bulb. Reagents used are DiSorbent (CO_2 absorption) and Oxsorbent (O_2 absorption).

1. Pre-sampling Preparation: Prior to sampling, equipment was inspected, cleaned, and checked for proper operation. Orsat bags to be used for sample collection were evacuated (see Figure IV-24) in the following manner:

Flexible tubing was connected to hose bib on the bag and the valve was opened on the bag. Using a hand pump, the bag was evacuated completely. While tubing was still connected to the hose bib, the valve was shut off and the tubing disconnected.

Leak checks of sampling trains were performed at sample locations just prior to sampling in the following manner. With probe tip plugged (or capped), the sample train was evacuated until the squeeze bulb collapsed. If the squeeze bulb remained collapsed for at least 30 seconds, the sample train was considered "leak free" from probe tip to discharge side of the squeeze bulb. With an Orsat bag unattached to the sample train, the flexible tubing was clamped or "pinched off" where it attached to the Orsat bag hose bib; the bulb with net was inflated by using a squeeze bulb. If the bulb with net remained inflated for at least 30 seconds, then the sample train was considered "leak free" from the discharge side of squeeze bulb to the point where flexible tubing connected to the Orsat bag.

2. Sample Collection: Without disconnecting the sample train, the probe was placed in the stack, making sure the probe tip was at least 3.5 feet into the stack, (i.e., sample point should be at least 3.5 feet from inner wall of stack). The probe was secured to the port opening to keep it from falling or vibrating excessively. The port opening was

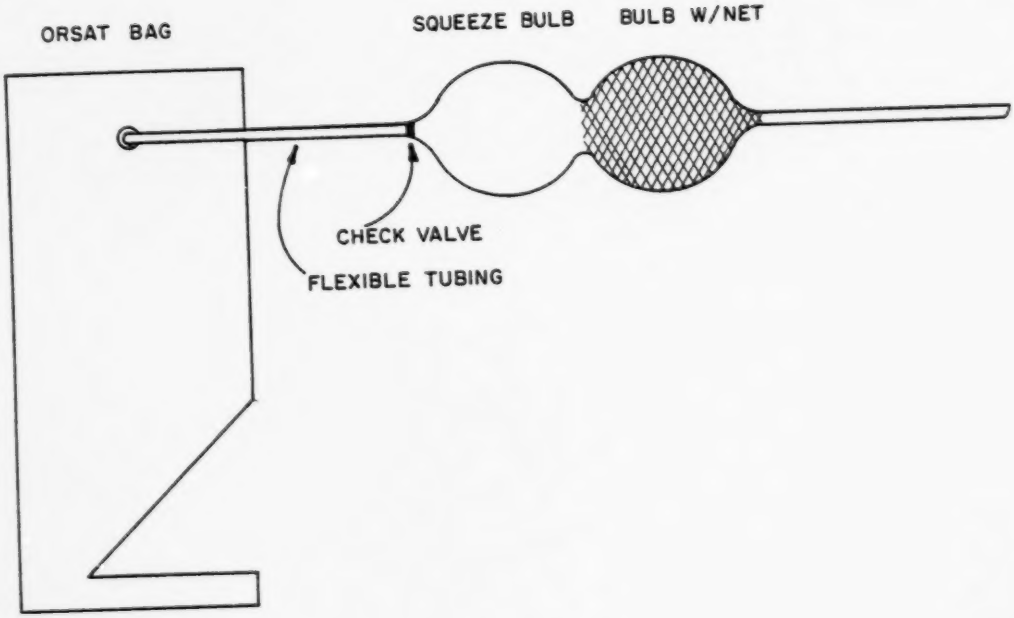


FIGURE IV-24. ORSAT BAG EVACUATION

covered with rags, duct tape, etc., to prevent ambient air from possibly diluting the sample. The sample train was then purged by using a squeeze bulb. After sufficient purging, (i.e., sample train completely clear of ambient air), pumping continued and the tip of the flexible tubing that connects to the Orsat bag was "pinched off". With the sample train completely assembled, (see Figure IV-25), the hose bib on the Orsat bag was opened and the bag was filled with sample gas. When the Orsat bag was full, the flexible tubing was disconnected. All pertinent data was recorded on the Gas Analysis Data Sheet (see Figure IV-26).

3. Sample Analysis: Prior to analyzing gas samples, a leak check was performed on the Orsat analyzers (see Figure IV-27) in the following manner. On each absorbing solution pipette, the absorbing solution liquid level was brought to the reference mark on capillary tubing by using a leveling bottle and then closing the pipette stopcock. Next, the leveling bottle was raised sufficiently to bring the liquid meniscus onto the graduated portion of the burette, closing the manifold stopcock. The meniscus position was recorded and observed; the level in each absorbing solution pipette was also observed over a 4-minute period (40 CFR Part 60, Appendix A, Method 3). If the liquid level in each absorbing solution pipette did not fall below the bottom of the capillary tubing and meniscus in the burette did not change by more than 0.2 ml during this 4-minute period, the Orsat analyzer was considered leak free.

Next, the liquid level in each absorbing solution pipette was determined to be at the reference mark. The manifold stopcock was set in position #2 and the water level in the burette was raised to the reference mark and the manifold stopcock was set in position #3. The hose bib on the Orsat bag was connected to the Tygon tubing on the Orsat manifold stopcock, and the hose bib on the Orsat bag was opened. The Tygon tubing was purged by applying pressure to the Orsat bag.

After purging, the manifold stopcock was set to position #4. By lowering the leveling bottle, the gas sample was drawn into a glass manifold and burette until meniscus was at the zero reference mark and then the manifold stopcock was set to position #1. The gas sample was run into the CO_2 absorbing solution pipette by opening the pipette stopcock and raising the leveling bottle (being careful not to run absorbing solution in the pipette past the reference mark). Next, the gas sample was run back into the burette.

Three complete passes were made. After the third pass, the absorbing solution level was run to the reference mark on the pipette and the pipette stopcock was closed. The leveling bottle water level was set at "even" with meniscus in the burette and the percent CO_2 was read directly from the graduated burette. A couple of more passes were made through the CO_2 absorbing solution and read again to ensure that CO_2 had been completey absorbed, i.e., until two consecutive readings were the same. The CO_2 reading was recorded.

The above procedure was repeated for O_2. The reading from the burette included the percent CO_2. The percent CO_2 was subtracted from this reading to get the percent O_2, and then recorded. If more than ten passes were required to obtain a constant reading for any component gas, the absorbing solution in that respective pipette was changed out.

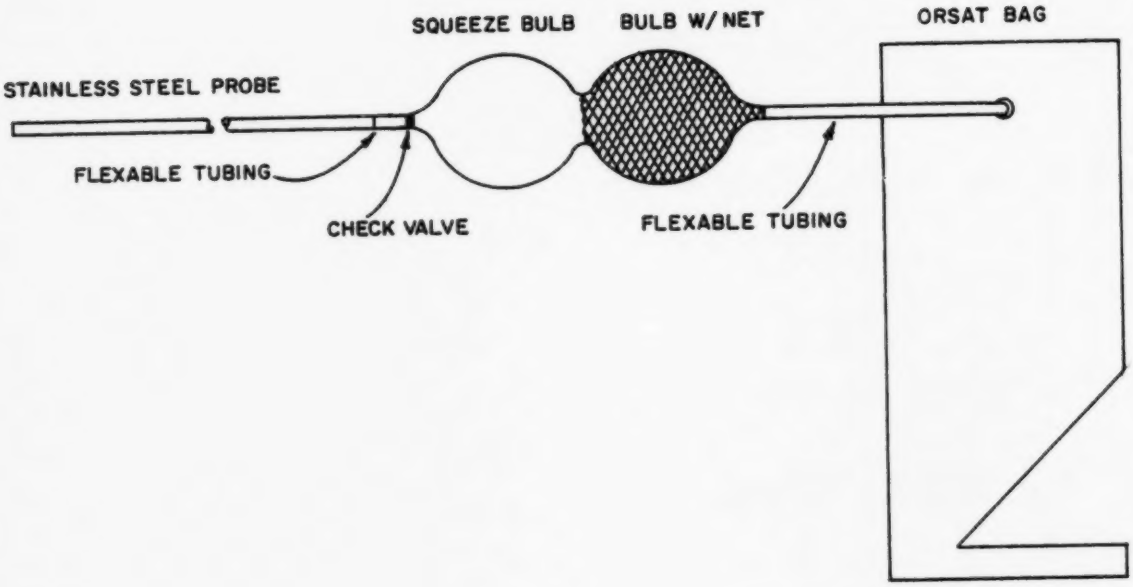


FIGURE IV-25. COMBUSTION GAS SAMPLING TRAIN

GAS ANALYSIS DATA

Plant/Location _____ Date _____

Purpose _____ Sample No. _____

ORSAT ☐

FYRITE ☐

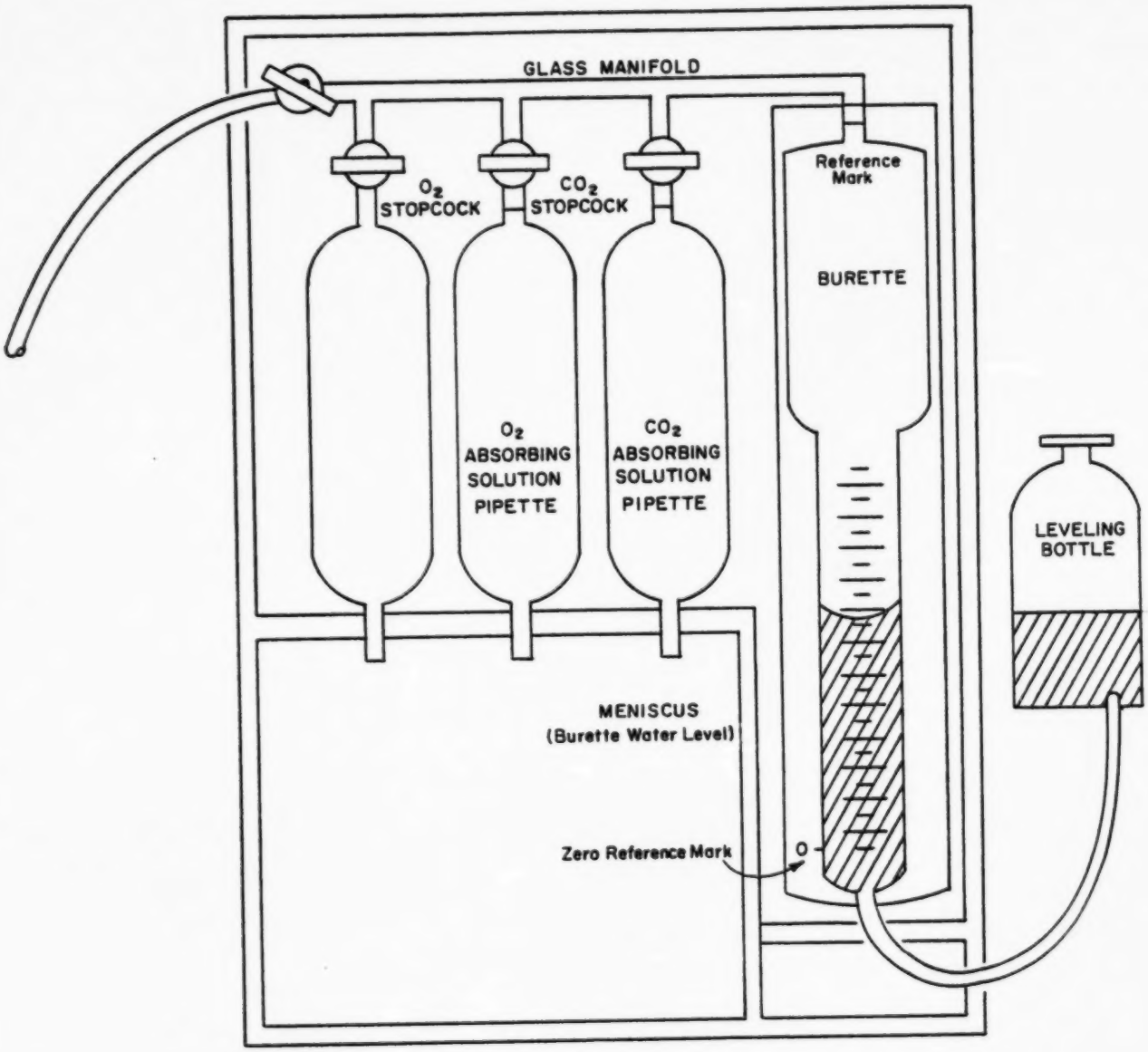
Bag No.	Time	Leak Ck.	CO_2	O_2	CO	
						Average
						Average
						Average

Sampled by _____

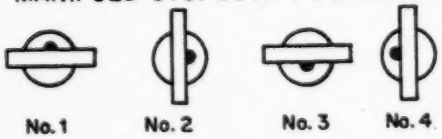
Analyzed by _____

FIGURE IV-26. GAS ANALYSIS DATA SHEET

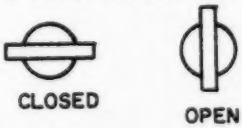
ORSAT ANALYZER



MANIFOLD STOPCOCK POSITIONS:



PIPETTE STOPCOCK POSITION



No. 1 - Closed.
No. 2 - Vents glass manifold to atmosphere.
No. 3 - Vents Tygon line to atmosphere.
No. 4 - Vents glass manifold to Tygon line.

FIGURE IV-27. ORSAT ANALYZER

This complete analysis was repeated until three consecutive analyses varied by no more than 0.5 percent (absolute) by volume for each gas component being analyzed. The final results, i.e., average of the three consecutive runs, were reported on a dry volume percentage basis.

4. Quality Assurance: A calibration check was performed before every third field test or before any field test in which the Orsat apparatus had not been checked during the previous three months. To check the O_2 absorbing reagent and the operator technique, the percent O_2 in air was determined. The average of three replicates should be 20.8 $\pm$ 0.7 percent. A higher than average reading will normally indicate operator error and a lower than average reading will indicate leaks, exhausted O_2 absorbing reagent, and/or operator error.

Orsat bags were periodically checked for leaks in the following manner. The bag was inflated with ambient air by using a hand pump. The Orsat hose bib was connected to a water-filled U-tube manometer. The hose bib was opened and pressure reading (should be at least two inches H_2O) was recorded. It was allowed to stand for at least 10 minutes and if pressure remained constant, the Orsat bag was considered leak free. All calibration checks with dates, dates reagents were changed out, dates Orsat was used, and dates that Orsat bags were leak checked were recorded in the Orsat Log Book.

E. Collection and Analysis For Particulate

1. Sample Collection: The impinger train used for the special testing program was set up with four Greenburg-Smith impingers. Each impinger had a modified tip. The first and second impingers were to have known amounts of water, the third empty, and the fourth silica gel. The weights of all four impingers were determined to the nearest 0.5 grams before use. A collection bottle was filled with some of the D.I. water and labeled "D.I. Water Blank". All openings where contamination might occur were kept covered until just prior to being assembled for use.

Using tweezers and rubber gloves, a pre-weighed, labeled filter was placed in the filter holder with the numbered side down. The filter apparatus was assembled, making sure the gasket was in the proper position. The particulate sampling train was assembled as shown in Figure IV-28.

A preliminary and post leak check was performed in the following manner. After the sampling train was completely assembled or disassembled, the probe tip was plugged with a rubber stopper and the control valve to the pump opened. A vacuum of at least 15 inches of Hg for a preliminary leak check and a vacuum equal to or greater than the maximum vacuum reached during sampling for a post leak check was pulled. The needle on the dry gas meter was observed for any movement after the vacuum was reached. A leak rate not to exceed two percent of the average sampling rate was acceptable; however, if the rate was not zero, all connections were checked. The plug was then released slowly and the pump valved off.

Before inserting the probe and beginning to sample, the Particulate Data Sheet (Figure IV-29) was checked to see that all the information required was filled out. After a good preliminary leak check was obtained, the initial dry gas meter reading was logged, along with all of

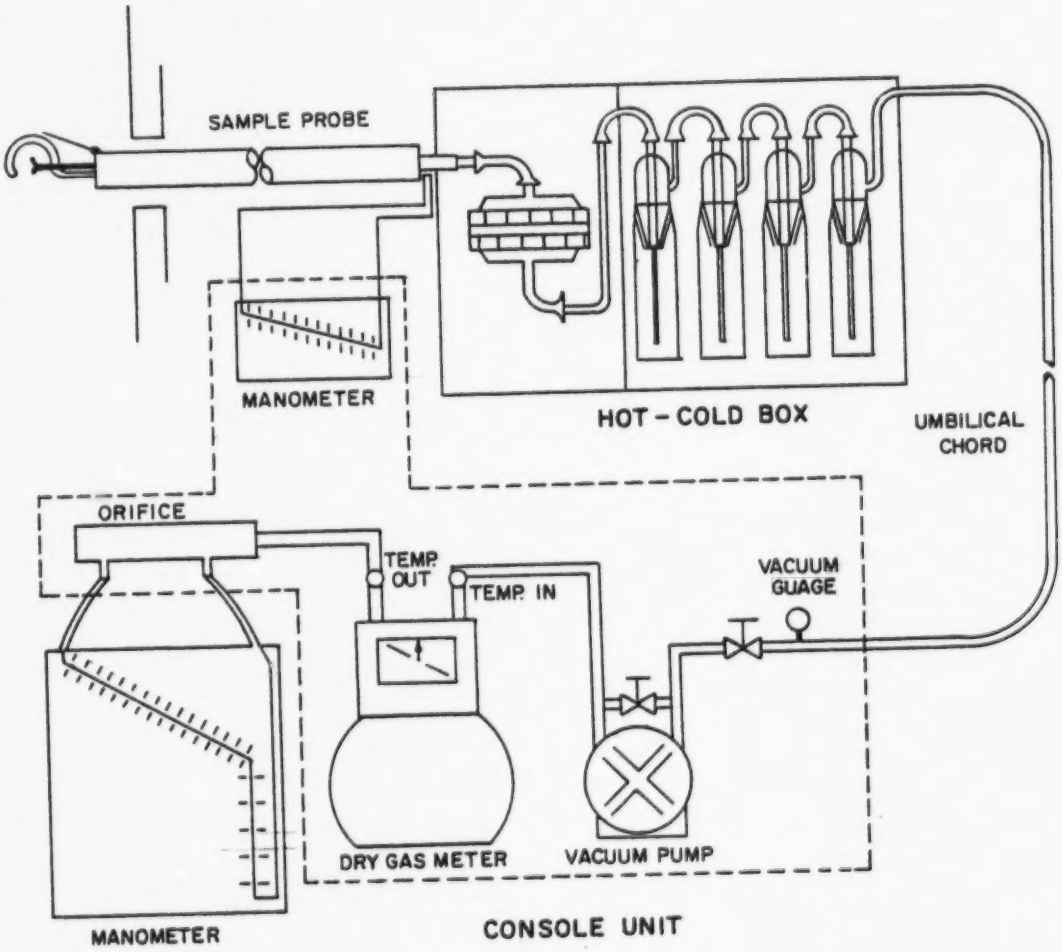


FIGURE IV-28. PARTICULATE SAMPLING TRAIN

SOUTHWESTERN PUBLIC SERVICE COMPANY

PARTICULATE DATA

Plant:_____ Date: _____

Sample Location:_____

Run Number:_____

COMPLETE THIS PART BEFORE SAMPLING

Meter Number:_____ Dry Gas Meter Cal. Factor:_____

Pitot Tube No.:_____ Pitot Tube Cal. Factor:_____

Probe Number:_____ Filter Number:_____

Nozzle Number:_____ Ambient Temp.:_____°F

Nozzle Diameter:_____ in., cm., mm. (circle one)

Uncorr. Bar. Pressure:_____in. Hg.

Prelim. Pitot Line Leak Check: o.k., not o.k., (circle one)

Prelim. Probe Leak Check: o.k., not o.k., (circle one)

(less than .02 cfm)

Leak Rate: _____ cf/_____min.

Static Pressure in Duct:_____in. H_2O

Operator: Initial when all prelim. checks finished_____

COMPLETE THIS PART AFTER SAMPLING AND BEFORE DISCONNECTING ANY LINES

Check Cold Box Temp._____

Check Hot Box Temp._____

Final Probe Leak Check: o.k., not o.k. (circle one)(less than .02 cfm)

Leak Rate: _____ cf/_____min.

Final Pitot Line Leak Check: o.k., not o.k. (circle one)

Operator Signature:

_____

Time: _____

Figure IV-29. Particulate Data Sheet

the other information required in the Particulate Field Data Form (Figure IV-30). The probe was then inserted into the stack to the inner most point and the pump valve opened. The delta H was immediately adjusted to the isokinetic value indicated by the nomograph. Adjustments to delta H in relation to the delta P were made immediately after moving to a new point. All data was recorded at each point. Close attention was paid to the amount of sampling time at each point. After completing all the points in one port, the pump was valved off and the sampling train moved to the next port. After the last port had been sampled, a post leak check was performed. A leak check was performed before and after disconnecting any portion of the sampling train during a run.

2. Sample Recovery: After completing the post leak check, the impingers were disconnected from the sampling train and capped. The hot box was removed and the glassware capped; the nozzle was removed and capped. The impingers, hot box, and nozzle were then taken to a relatively dust free lab environment for recovery.

The probe was usually washed on the sampling site due to the difficulty in removing it from the site. Any exterior surfaces near the collection end of the probe were wiped off. Any grease on the end that was connected to the glassware was wiped off. The probe liner was then rinsed with analytical reagent grade acetone, catching the washings in the collection bottle. After rinsing, the probe liner was washed using a probe brush and acetone. These washings were added to the collection bottle. The washing procedure was continued until the washings were free of particulate. If there was no visible particulate in the washings, the probe liner was washed at least three times. A separate collection bottle was filled with acetone at each sampling location and labeled "acetone blank". The labels on the collection bottles were filled out completely.

If a probe extension was used between the hot box and cold box and if it was determined that the impinger catch (back half of sampling train) was to be analyzed, the extension was rinsed with water several times. The nozzle was wiped free of exterior particulate and then rinsed with acetone. Next, a nozzle brush and acetone were used to scrub the nozzle clean. All washings were added to the collection bottle.

The glassware in the hot box was disassembled and the particulate caught in the cyclone flask was washed into the collection bottle. The filter holder was taken apart very carefully and the filter, along with the gasket, removed with tweezers. The filter and gasket were placed in the petri dish that the filter was stored in. The petri dish was then sealed with tape. The cyclone, filter holder glassware, fritted disc, and connecting hot box glassware were rinsed with acetone and the washings added to the collection bottle.

The impingers were disconnected and any water or grease on the exterior wiped off. Each impinger was then weighed and this information recorded on the Moisture Fraction Form (Figure IV-31). If it was determined that the impinger catches were analyzed for particulate, they were poured in collection bottles and rinsed with D.I. water. While going through the recovery procedures, all blanks on the recovery form (Figure IV-32) were filled out and the form was signed by all of those involved or in charge of the recovery.

PARTICULATE FIELD DATA

Plant: _____ Sample Location: _____ ; Run _____ Date: _____

Port No.: _____ Start Time: _____ Operator: _____

Point No.	Time (h h : m m)	Dry Gas Meter Reading, cu. ft.	ΔP in. H_2O	ΔH in. H_2O	Dry Gas Meter Temp., °F In	Dry Gas Meter Temp., °F Out	Vacuum in. Hg	Hot Box Temp., °F	Stack Temp., °F	Cold Box Temp., °F	ISTOPT
1 2 3	4 5 6 7 8 9	10 11 12 13 14 15 16 17	18 19 20 21 22	23 24 25 26 27	28 29 30 31 32	33 34 35 36 37	38 39 40 41 42	43 44 45 46 47	48 49 50 51 52	53 54 55 56 57	58 59 60 61 62

Port No.: _____ Start Time: _____ Operator: _____

Point No.	Time (h h : m m)	Dry Gas Meter Reading, cu. ft.	ΔP in. H O	ΔH in. H O	Dry Gas Meter Temp., °F In	Dry Gas Meter Temp., °F Out	Vacuum in. Hg	Hot Box Temp., °F	Stack Temp., °F	Cold Box Temp., °F	ISTOPT
1 2 3	4 5 6 7 8 9	10 11 12 13 14 15 16 17	18 19 20 21 22	23 24 25 26 27	28 29 30 31 32	33 34 35 36 37	38 39 40 41 42	43 44 45 46 47	48 49 50 51 52	53 54 55 56 57	58 59 60 61 62

791226GATC

FIGURE IV-30. PARTICULATE FIELD DATA FORM

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

_____

_____

CONDENSER METHOD

Meter Temp Inlet	_____	_____	_____	_____	_____
Meter Temp Outlet	_____	_____	_____	_____	_____

Average Temp. _____ °F TM = Average temp. + 460 = _____ °R

	First Impinger	Second Impinger	Third Impinger	Silica Gel
Final Wt.	_____	_____	_____	_____
Initial Wt.	_____	_____	_____	_____
Difference	_____	_____	_____	_____
Total	_____			

Pressure at Meter, PM, _____ inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final _____

Initial _____

Net Volume _____ ft^3

Corrected Volume (V)

Dry Gas Meter Calibration Factor, DGMCF _____

V = (Net Vol) x (DGMCF) = ( ) x ( ) = _____ ft^3

$$\text{Moisture Fraction} = \frac{(MWC) \times 1.339 \frac{\text{liters}}{\text{gm } H_2O}}{\left[(MWC) \times 1.339 \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(V) \times (PM)}{(TM)} \times 501.7 \frac{\text{liters °R}}{ft^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(\quad) \times 1.339}{\left[(\quad) \times 1.339\right] + \left[\frac{(\quad) \times (\quad)}{(\quad)} \times 501.7\right]}$$

= _____

Dry Gas Fraction = 1 - (moisture fraction) = 1 - ( ) = _____

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction _____

Average Dry Gas Fraction _____

FIGURE IV-31. MOISTURE FRACTION FORM

Reproduced from best available copy.

Check List For Recovery of Particulate Samples

Run No._____

Circle yes or no for each item.

1.	Was the fritted disc broken or chipped?	YES	NO
2.	Did the fritted disc contain visible particulate?	YES	NO
3.	Was the filter torn or damaged in any way?	YES	NO
4.	Was the impinger catch discolored by particulate?	YES	NO
5.	Was there condensation or other unusual material in the cyclone flask?	YES	NO

Other comments:

Check to see that the following have been done:

1. Levels of containers marked.
2. Labels on containers filled out completely.

Recovered by_____

Figure IV-32. Check List for Recovery of Particulate Samples

3. Sample Analysis: Before the analysis of the particulate catches were done, there had to be a sufficient number of evaporating dishes brought to constant weight. To do this, the dishes were cleaned and then placed in an oven at 105°C and left for 24 hours, then placed in a desiccator and cooled. Each dish was then weighed and placed back in the desiccator. This procedure continued until two consecutive weighings that agreed within 0.0005 grams were obtained. The average of those weighings was taken as the initial weight or tare weight.

The filters and gaskets were treated in the following manner. Using tweezers, the filter was separated from the gasket and folded with the particulate cake inside. It was then placed in an evaporating dish. The gasket was carefully scraped with a scalpel to remove any filter material stuck to it. This material was placed in the evaporating dish with the filter. The gasket was washed off in the petri dish with isopropanol (acetone will dissolve the petri dish). Then the petri dish was washed with isopropanol into an evaporating dish. An equal amount of isopropanol that was used for washing was collected in a dish and used for a blank.

The acetone washings were poured into evaporating dishes. The collection bottles were rinsed out until no more particulate was visible. These evaporating dishes, along with the isopropanol washings, were placed in the evaporation chamber and the fan turned on. After evaporation, the dishes were placed in a desiccator for at least 24 hours.

After desiccation, the dishes were weighed and the procedure for desiccation and weighing was repeated until a constant weight was obtained. The blanks were treated in the same manner as the washings. Blank volumes should correspond to the volumes used for washing; if not, the exact volumes used were recorded. Results of the weighings were recorded on the appropriate forms for submission. (See Figures IV-33 and IV-34.)

4. Reagents for Particulate:

D.I. Water (as furnished by System Lab).

Acetone (reagent grade, $\geqq$ 0.001 percent residue, in glass bottles).

Isopropanol (reagent grade).

Filters (Reeve Angel 900 AF glass fiber).

F. Calibration and Standardization For Particulate

1. Acetone Residual Purity Check: Each lot of acetone used in recovery was checked for purity before use. Results were recorded on the Acetone Purity Check Form, Figure IV-35. To do this, 500 ml of acetone was poured into a tared evaporating dish and evaporated. The weight gain was obtained after desiccation. The weight gain should not be greater than 0.001 percent of the weight of acetone used. For a 500 ml sample, this would be no more than about 3.93 mg weight gain. The exact amount would depend on the density of the acetone in the lot.

2. Dry Gas Meter Calibration: An initial and final calibration was done on the dry gas meter. The procedure used for the calibration of the dry gas meters can be found in the Calibrations Section.

Particulate Results

Plant _____ Particulate Run # _____

Location _____ Date Sampled _____

Purpose _____ Date Recovered _____

Filter # _____

	Evap. Dish #	Final Weight	Tare Weight	Weight Gain
Acetone Blank				
Isopropanol Blank				
Total Blank Weight				

	Evap. Dish #	Final Weight	Tare Weight	Weight Gain
Filter + Evap. Dish				
Filter Washings				
Probe & Glassware				
Washings				
Total Weight Gain				

(Total Weight Gain)-(Total Blank Weight) = (Net Weight Gain)

_____ - _____ = _____

FIGURE IV-33 PARTICULATE BLANK RESULTS

PARTICULATE RESULTS

Plant _____ Particulate Run # _____

Location _____ Date Sample _____

Purpose _____ Date Recovered _____

Filter # _____

	Evap. Dish #	Final Weight	Tare Weight	Weight Gain
Filter + Evap. Dish				
Filter Washings				
Probe & Before Filter Glassware Washings				
Impinger & After Filter Glassware Washings				
Total Weight Gain				

(Total Weight Gain) - (Total Blank Weight) = (Net Weight Gain)

_____ - _____ = _____

FIGURE IV-34. PARTICULATE RESULTS

Acetone Purity Check

For Total Dissolved Solids

Date Acetone Received_____

Lot #_____

Checked by_____

Date Checked_____

Evaporating Dish #	Final Weight	Initial Weight	Net Weight

Figure IV-35. Acetone Purity Check Form

3. Orifice Calibration: The calibration of the orifice was done before each test. The procedure to be used for the calibration of the orifice can be found in the Calibrations Section.

4. Magnehelic Calibrations: Any magnehelic used for the measurement of pressure differentials was calibrated against incline manometers. The procedure used for these calibrations can be found in the Calibrations Section.

5. Reporting of Results: The results of the analysis were reported to Engineering Services as net weight gain in grams. This value was calculated according to the following formula:

$$\text{Total Weight Gain} - \text{Total Blank Weight} = \text{Net Weight Gain} \quad (10)$$

The total blank weight must be adjusted by using a multiplication factor if the volume of the blank was not the same as the sample volume. All other calculations were done by Engineering Services.

6. Quality Assurance: As a check on the quality of the data collected, the standard deviation of the PMR (Particulate Mass Emission) for the three runs was calculated along with the 90 percent confidence limits. The formulas for these calculations are as follows:

$$S\ PMR = \frac{(PMR_1 - \overline{PMR})^2 = (PMR - \overline{PMR})^2 = (PMR - \overline{PMR})^2_3}{2}^{1/2} \quad (11)$$

where

S PMR = The calculated standard deviation for the three sample runs

PMR_1,

PMR_2,

PMR_3 = Particulate Mass Emission rate for sample run 1, 2, and 3

$\overline{PMR}$ = Average particulate mass emission rate of the three sample runs.

2 = Number of replicates minus one.

$$90\%\ \text{confidence limit} = \overline{PMR} \pm (2.92)\ (S\ \{PMR\})/\sqrt{n} \quad (12)$$

where

$\overline{PMR}$ = The average of the three replicates

S PMR = Estimated standard deviation of PMR based on three replicates

2.92 = 95th percentile of the student t - distribution with 2 degrees of freedom

n = The number of replicates, i.e., n = 3 for this case.

Example:

For a given field test, $\overline{PMR}$ = 22.86 g/hr. and S $\left\{PMR\right\}$ 1.32g/hr.

The reported value with 90% confidence limits would be

$$22.86\text{g/hr.} \pm (2.92)\ (1.32\text{g/hr.})\ /3 \qquad (13)$$

or

$\overline{\overline{PMR}}$ (grand mean particulate mass emission) is

$\overline{\overline{20.6}}$g/hr. $\leq \overline{\overline{PMR}} \leq$ 25.1g/hr.

G. Collection and Analysis For SO_2

1. Sample Collection: The sampling train was set up with five midget impingers. The first impinger contained 15 ml of 80 percent isopropanol. The second and third impingers contained 15 ml of 3 percent hydrogen peroxide. The fourth impinger was empty and the fifth contained silica gel. The train was assembled as shown in Figure IV-36, making sure that the connecting glassware was on the impingers in the correct sequence. Crushed ice was placed around the impingers. A collection bottle was filled with some of the H_2O_2 and labeled "H_2O_2 Blank."

A preliminary and a post leak check performed in the following manner. After the sampling train was completely assembled, the probe tip was plugged with a rubber stopper and the control valve to the pump opened. A vacuum of at least 5 inches of Hg was pulled. The needle on the dry gas meter was observed for any movement after the vacuum was reached. A leak rate not in excess of two percent of the average sampling rate was acceptable; however, if the rate was not zero, all connections were checked. The plug was then released slowly and the pump valved off.

After a good preliminary leak check was obtained, the initial dry gas meter reading was logged, along with all of the other information

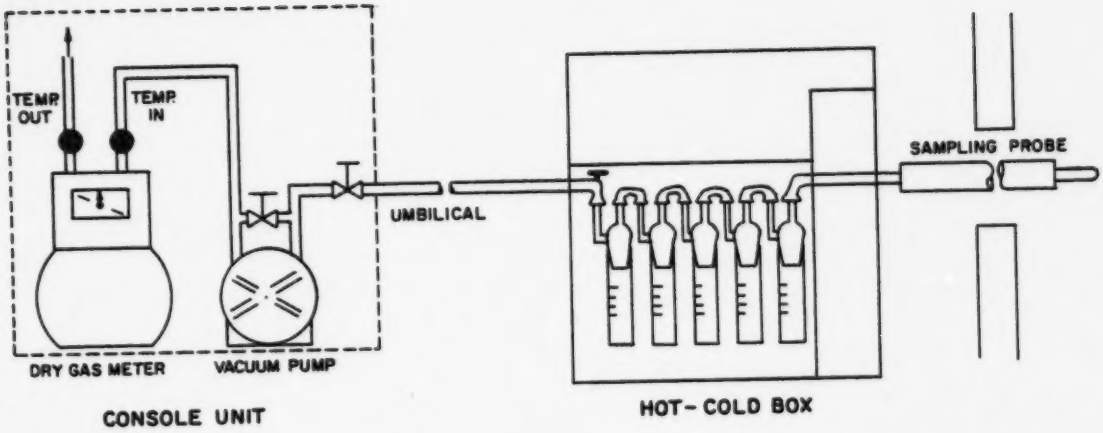


FIGURE IV-36. SO_2 SAMPLING TRAIN

requested on the SO_2 Sample Field Data Form (Figure IV-37). The probe was then inserted into the stack and the pump control valve opened and adjusted to the pre-determined sampling rate. Readings were logged every five minutes during sampling. At the conclusion of the run, the pump control valve was closed, the readings recorded, and a post leak check conducted in the same manner as described on the preceding page. After the leak check had been completed, the probe from the impinger train was disconnected and the train was purged with clean ambient air for 15 minutes.

2. Sample Recovery: After purging for 15 minutes, the connecting glassware was disconnected and laid aside. The number of ml in each impinger was noted and recorded. The contents of impinger #1 were poured into a collection bottle and labeled "isopropanol." Contents of the #2, #3, and #4 impingers were poured into a separate collection bottle. These impingers and their connecting glassware were washed with D.I. water and these washings added to the collection bottle. The container level was marked and the label (Figure V-38) was completely filled out after completing the recovery procedure. A collection bottle was filled with D.I. water and labeled "D.I. Water Blank." The containers were then sealed with tape if there was going to be an extended period of time between collection and analysis. A recovery check list was provided for each run and was filled out completely and signed at the conclusion of the recovery procedures. (See Figure IV-39.)

3. Sample Analysis: The level of the liquid in the collection bottle was noted and if there was any loss, it was indicated on the analysis form (Figure IV-40). The contents of the bottle were transferred to a volumetric flask big enough to allow for the dilution of each sample to a constant volume. A 20-ml aliquot or an aliquot of sufficient volume to require at least 5 ml of 0.01N barium perchlorate solution for titration was pipetted into an Erlenmeyer flask. Eighty ml of 100 percent isopropanol and four drops of Thorin indicator were added. The sample was titrated with 0.0100N barium perchlorate to the salmon pink endpoint. The titration was repeated on a second aliquot. The replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger. If the replicate titrations agreed according to the limits, the two numbers were averaged and used for V_t in the formula. V_a was the volume of the aliquot. V_{soln} was the constant volume that each sample was diluted to. Results were recorded on the SO_2 Data Summary Form (Figure IV-41).

A blank was run with each set of analysis. The blank consisted of a volume of deionized water and H_2O_2, the same as the aliquot used and 80 ml of 100 percent isopropanol. A set of standards was also run with each set of analysis for quality assurance. The preparation of these standards is described under Reagents. The treatment of the quality assurance data is covered under Quality Assurance.

4. Reagents for SO_2:

80 percent AR Grade Isopropanol prepared from 100 percent isopropanol.

3 percent H_2O_2 (prepared daily, diluted 10 ml of the 30 percent solution to 100 ml with D.I. water).

SO_2 SAMPLE FIELD DATA

EPA METHOD 6

PLANT/LOCATION _____ DATE _____

PURPOSE _____ OPERATOR _____

Pbar _____ in. Hg. METER NO. _____ D.G.M.C.F. _____

SAMPLE NO. _____ PRE LEAK CK. _____ POST LEAK CK. _____

PORT	TIME	DRY GAS MTR. READING	ΔP in.Hg	ΔH in.Hg	DRY GAS MTR. TEMPERATURE		VAC in. Hg	HOT BOX TEMP. °F	COLD BOX TEMP. °F	STACK TEMP. °F
					IN	OUT				

TOTAL SAMPLE TIME _____ MIN. _____ X _____ = _____ $ft.^3$

Net Vol. D.G.M.C.F. Corrected Vol. at Meter Cond.

SAMPLE NO. _____ PRE LEAK CK. _____ POST LEAK CK. _____

PORT	TIME	DRY GAS MTR. READING	ΔP in. Hg	ΔH in. Hg	DRY GAS MTR. TEMPERATURE		VAC in. Hg	HOT BOX TEMP. °F	COLD BOX TEMP. °F	STACK TEMP. °F
					IN	OUT				

TOTAL SAMPLE TIME _____ MIN. _____ X _____ = _____ $ft.^3$

Net Vol. D.G.M.C.F. Corrected Vol. at Meter Cond.

FIGURE IV-37. SO2 SAMPLE FIELD DATA FORM

Plant _____

Location _____

Sample # _____

Date _____

Recovered by _____

Figure IV-38. Bottle Label

Check List For Recovery of SO_2 Samples

Run No._____

1. Indicate the approximate volume of liquid in each impinger to the nearest ml.

_____	_____	_____	_____	contains silica gel
#1	#2	#3	#4	#5

2. Indicate if there was any discoloration in the impinger liquid by circling either yes or none.

yes/none	yes/none	yes/none	yes/none	yes/none
#1	#2	#3	#4	#5

3. indicate the extent that the silica gel was spent by circling one of the following:

slightly pink localized pink almost entirely pink

Other comments:

Recovered by_____

Check to see that the following have been done:

1. Levels of containers marked.
2. Lables on containers filled out completely.
3. Container sealed for shipment.
4. H_2O_2 and D.I. water blanks collected.

Figure IV-39. Check List for Recovery of SO_2 Samples

SO_2 ANALYSIS
EPA METHOD 6

Plant Name: _____

Purpose: _____

Date Sampled: _____

Date Analyzed: _____

Analyst: _____

Titrant: _____

Normality of Titrant: _____

Was there any loss of sample during transport? Yes_____ No_____

If yes, which containers: _____

Sample No.	Ml of Titrant Used			Total Solution Volume	Volume of Aliquot
	1	2	Avg.		

FIGURE IV-40. SO_2 ANALYSIS FORM

SO_2 DATA SUMMARY

FIGURE IV-41. SO_2 DATA SUMMARY FORM

Plant Name: _____

Location: _____

Purpose: _____

Date Sampled: _____

Date Analyzed: _____

Run No.	Vol.@Meter Conditions Vm	Uncorrected Barometric Pres. Pbar	Average Meter Temp Tm	Vol.of Titrant for Sample Vt	Vol.of Titrant for Blank Vtb	Normality of Titrant N	Total Sample Vol. Vsoln	Vol. of Aliquot Va	% Oxygen O_2	Comments

Primary standard KHP (for standardization of NaOH): dried about 3 grams of KHP ($KHC_8 HH_4 O_4$) at 110°C for one hour and then cooled for at least 30 minutes in a desiccator. Weighed out and dissolved 0.025 grams, 0.050 grams, and 0.100 grams of the standard KHP in 50 ml of D.I. water.

0.01 N NaOH solution (for standardization of H_2SO_4): dissolved 0.40 grams of NaOH in 300 ml of D.I. water and diluted to one liter.

0.01N H_2SO_4 (for standardization of $Ba(ClO_4)_2$): added 3 ml of concentrated H_2SO_4 to 500 ml of D.I. water and diluted to one liter. Took 100 ml of this solution and diluted to one liter.

0.01N barium perchlorate solution: dissolved 1.95 grams of barium perchlorate [$Ba(ClO_4)_2 \cdot 3H_2O$] in 200 ml of D.I. water and diluted to one liter with A.R. grade isopropanol.

Phenolphthalein Indicator: used as prepared by the System Lab.

Thorin Indicator: dissolved 0.20 grams of Thorin Indicator in 100 ml of D.I. water.

10 Percent Potassium Iodide Solution: dissolved 10 grams of KI in D.I. water and diluted to 100 ml.

5. Standard Quality Assurance Samples: All standards were made from dilutions of a 1N solution of H_2SO_4. For the 1N H_2SO_4 solution, 26.7 ml of concentrated H_2SO_4 was diluted (specific gravity of 1.84) to one liter. The 1N solution was standardized in the same manner that the H_2SO_4 solution used for barium perchlorate standardization was done. The weight of KHP was 2.0000 g, 1.0000 g, and 0.4800 g. After the 1N solution of H_2SO_4 had been standarized, it was used in the following manner for each standard:

80 Percent Range Standard (0.0048N H_2SO_4): added 4.8 ml of 1N H_2SO_4 solution to a 1-liter volumetric flask and diluted to the line.

Median Range Standard (0.0028N H_2SO_4): added 2-8 ml of 1N H_2SO_4 solution to a 1-liter volumetric flask and diluted to the line.

20% Range Standard (0.0012N H_2SO_4): added 1.2 ml of 1N H_2SO_4 solution to a 1-liter volumetric flask and diluted to the line.

These standards were approximately equivalent to the following amounts of SO_4:

80 Percent Range Standard	-	0.235 mg/ml
Median Range Standard	-	0.137 mg/ml
20 Percent Range Standard	-	0.059 mg/ml

H. Calibrations and Standardization for SO_2

1. Isopropanol Purity Checks: Each lot of isopropanol was checked for peroxide impurities. To do this, 10 ml of isopropanol was shaken with 10 ml of freshly prepared 10 percent KI. A blank was prepared

using 10 ml of D.I. water. After one minute, the absorbance was read at 352 nanometers on a spectrophotometer. The absorbance must not exceed 0.1. A form for recording this procedure was provided (see Figure IV-42).

2. Dry Gas Meter Calibration: An initial and final calibration was done on the dry gas meter. The procedure used for the calibration of the dry gas meters can be found under Calibrations in this report. The initial and final calibration factors must not deviate by more than 5 percent. If they differ by more than 5 percent, the calibration factor that would yield the lower gas volume for each test run was used.

3. Standardization of Barium Perchlorate: the standardization for the barium perchlorate titrant was performed using a standard solution of H_2SO_4 which is standardized using a standard solution of NaOH which is standardized using primary standard KHP. Results were recorded on Figure IV-43.

4. Standardization of NaOH (used form shown in Figure IV-44):

Prepared the three KHP solutions and the NaOH solution as described in the Reagent Section of these procedures.

Added two or three drops of phenolphthalein to the first KHP solution and titrated with the NaOH until the pink endpoint was reached.

Recorded the number of ml required for each sample and calculated the normality of the NaOH using the following formula:

$$N = \frac{M}{(V_t)\ (204.22)} \tag{14}$$

where

N = Normality of the NaOH
M = mg of KHP used
V_t = Volume of NaOH solution used (ml)
204.22 = Equivalent weight of KHP.

Averaged the normalities calculated for all three samples and assigned this value to the solution. Put the normality and date of standardization on the container.

5. Standardization of H_2SO_4 (used form shown in Figure IV-45):

Prepared the H_2SO_4 solution as described in the Reagent Section of these procedures.

Titrated two or three 20 ml samples of H_2SO_4 with the standard NaOH solution to the faint pink endpoint.

Calculated the normality of the H_2SO_4 solution using the following equation:

$$N_2 = \frac{N_1\ V_1}{V_2} \tag{15}$$

Isopropanol Check for Peroxide Impurity

Lot # _____

Absorbance

Blank

Sample #1

Sample #2

Sample #3

Absorbance Must Be 0.1

Figure IV-42. Isoproponal Check for Peroxide Impurity

Standardization of Barium Perchlorate

Date_____

Solution I.D. #_____

Analyst_____

Normality of H_2SO_4_____

Sample #	ml of Standard H_2SO_4 Used	ml of $Ba(ClO_4)_2$ Titrant Used

Calculations:

$$N_2 = \frac{N_1 V_1}{V_2}$$

Where

N_2 = Normality of $Ba(ClO_4)_2$

N_1 = Normality of H_2SO_4

V_1 = Volume of H_2SO_4 titrated

V_2 = Volume of $Ba(ClO_4)_2$ titrant used

Sample #	Normality of $Ba(ClO_4)_2$

Average

Figure IV-43. Standardization of Barium Perchlorate

Standardization of NaOH

Date_____

Solution I.D. #_____

Analyst_____

Sample #	mg of KHP Used	ml of NaOH Titrant

Calculations:

$$N = \frac{m}{(V_t)(204.22)}$$

Where

N_2 = Normality of NaOH

m = mg of KHP used

V_t = Volume of NaOH titrant used

204.22 = Equivalent weight of KHP

Sample #	Normality of NaOH

Average

Figure IV-44. Standardization of NaOH

Standardization of H_2SO_4

Date_____

Solution I.D. #_____

Analyst_____

Normality of NaOH_____

Sample #	ml of H_2SO_4 Solution Titrated	ml of NaOH Titrant Used

Calculations:

$$N_2 = \frac{N_1 \ V_1}{V_2}$$

where

N_2 = Normality of H_2SO_4

N_1 = Normality of the NaOH solution

V_1 = Volume of NaOH titrant used

V_2 = Volume of H_2SO_4 titrated

Sample #	Normality of H_2SO_4

Average

Figure IV-45. Standardization of H_2SO_4

where

N_2 = Normality of the H_2SO_4
N_1 = Normality of the NaOH solution
V_1 = Volume of NaOH titrant used (ml)
V_2 = Volume of H_2SO_4 titrated.

Averaged the three normalities and assigned that value to the H_2SO_4 solution. Put the normality and date of standardization on the container.

The standard H_2SO_4 solution was used repeatedly once it had been standardized. However, if the date on the bottle indicated that it was more than six months old, it was discarded and a new solution standardized.

6. Standardization of the Barium Perchlorate Solution: Prepared the barium perchlorate as described in the Reagent Section of these procedures.

Prepared three samples containing 25 ml of standard H_2SO_4 and 100 ml of isopropanol.

Added four drops of Thorin indicator and titrated with Ba $(ClO_4)_2$ to the endpoint.

Calculated the normality of $Ba(ClO_4)_2$ by using the following formula:

$$N_2 = \frac{N_1 V_1}{V_2} \tag{16}$$

where

N_2 = Normality of $Ba(ClO_4)_2$
N_1 = Normality of H_2SO_4 solution
V_1 = Volume of H_2SO_4 solution titrated
V_2 = Volume of $Ba(ClO_4)_2$ titrant used.

Averaged the normalities from all three titrations and assigned that normality to the $Ba(ClO_4)_2$ solution. Labeled the bottle with the normality and date of standardization.

The level left in the H_2SO_4 bottle and the $Ba(ClO_4)_2$ bottle was marked each time an amount was used. All precautions were taken to prevent the evaporation of the solutions after standardization.

I. Calculations of Final Results

The System Lab used a computer program from its file which calculated the dry gas volume at standard conditions (V_{mstd}); concentration of SO_2 in lb/dscf (C_{SO_2}); concentration of SO_2 in ppm; and concentration in lb/10^6 Btu. A file copy of the program can be found in Table IV-I.

The program used the following formulas to calculate the results.

```
0001          READ  (5,100,END=999) F, NSAMP
0002      100 FORMAT (F6.0,12)
0003          WRITE(6,104)
0004      103 FORMAT(1H //13X, 'VMSTD',8X,'CS02',9X,'PPM',
             &6X, 'LB/10**6BTU',4X,'RUN'
             &/13X,'(DSCF)',3X,'(LB/DSCF)',32X,'NO.')
0005      104 FORMAT(1H1,25X,'SOUTHWESTERN PUBLIC SERVICE CO.',
             &/35X,'SYSTEM LAB',
             &/33X'SULFUR DIOXIDE')
0006          WRITE (6,103)
0007        2 CONTINUE
0008          TCSO2 = 0.
0009          TPPM = 0.
0010          E = 0.
0011          DO 3 I=1,NSAMP
0012          READ (5,101) J,VM,PBAR,TM,VT,VTB,AN,VSOLN,VA,02
0013      101 FORMAT(A5,F6.3,F6.2,F5.0,F5.2,F5.2,F5.2,F5.0,F4.0,F4.1)
0014          VMSTD = 17.65 * VM * PBAR /TM
0015          CS02=((7.061E-5)*(VT-VTB)*AN*(VSOLN/VA))/VMSTD
0016          PPM = CS02 /1.659413E-7
0017          E = CS02 * F * 20.9 /(20.9 - 02)
0018          WRITE (6,102) VMSTD,CS02,PPM,E,J,
0019      102 FORMAT(//10X,F8.2,2X,F10.7,4X,F8.2,6X,F8.6,5X,A5)
0020          TCS02 = TCS02 + CS02
0021          TPPM = TPPM + PPM
0022          TE = TE + E
0023        3 CONTINUE
0024          ACS02 = TCS02 / NSAMP
0025          APPM = TPPM / NSAMP
0026          AE = TE / NSAMP
0027          WRITE(6,106)
0028      106 FORMAT(1H ,20X,'----------',4X,'--------',
             &5x,'--------')
0029          WRITE(6,107)
0030      107 FORMAT(1H ,1X,'AVERAGE')
0031          WRITE(6,108)ACS02,APPM,AE
0032      108 FORMAT(1H ,19X,F10.7,4X,F8.2,6X,F8.6)
0033          READ(5,100,END=999)F,NSAMP
0034          IF(F.NE.0.) GO TO 2
0035          WRITE(6,105)
0036      105 FORMAT(1H-,/////40X,'--------------------------',
             &/40X,'PREPARED BY')
0037      999 STOP
0038          END
```

TABLE IV-1. DRY GAS VOLUME COMPUTER PROGRAM

SO_2 Calculations

$$Vm_{(std)} = 17.65\ (dgmcf)\ \frac{(V_m\ P_{bar})}{T_m} \qquad (17)$$

where

$V_m(std)$ = dry gas volume measured by dry gas meter (standard conditions) (dscf)

$17.65 = \frac{\text{std. temp}}{\text{std. press.}} = \frac{528^\circ\ R}{29.92\ \text{in Hg}}$

dgmcf = dry gas meter correction factor

V_m = dry gas volume as measured by dry gas meter (dcf) without (dgmcf)

T_m = Avg. dry gas meter absolute temperature (°R)

P_{bar} = barometric pressure at dry gas meter orifice (in. Hg).

$$C_{SO_2} = (7.061 * 10^{-5})\ \frac{(V_t - V_{tb})\ N\ \left(\frac{Vsoln}{V_a}\right)}{Vm(std)} \qquad (18)$$

where

C_{SO_2} = concentration of sulfur dioxide, dry basis, standard conditions (lb/dscf)

$7.061 * 10^{-5}$ = conversion factor (lb/meq)

V_t = volume of barium perchlorate titrant used for sample (ml)

V_{tb} = volume of barium perchlorate titrant used for blank (ml)

N = normality of barium perchlorate titrant (meq/ml)

V_{soln} = total solution volume of sulfur dioxide sample (ml)

V_a = volume of sample aliquot titrated (ml).

To convert C_{SO_2} in lb/dscf to ppm:

$$ppm = \frac{C_{SO_2}}{(2.59 * 10^{-9})\ (64.07)} \qquad (19)$$

$$E = (C)\ (F)\ \frac{20.9}{20.9 - \text{percent } O_2} \qquad (20)$$

where

E	= concentration in lb/10^6 BTU
C	= concentration in lb/dscf
F	= factor specific for type of fuel being burned
percent O_2	= O_2 as measured by Orsat
20.9	= concentration of O_2 in air.

J. Quality Assurance

Four control charts were maintained during the special testing program to assure the quality of the data reported for SO_2 determinations. The charts for the three standard solutions were run with each batch of samples. The mg of SO_2 present (as determined by the titration procedure) was used to figure the percent difference in the measured value from the true value. This percent difference was plotted versus the date of analysis making up the control chart. (See Figure IV-46.) The formulas for calculation of mg of SO_2 and percent difference are as follows:

$$m = (N)\ (V_t)\ (49.04) \qquad (21)$$

where

m	= mg of H_2SO_4 present
N	= normality of barium perchlorate titrant
V_t	= ml of barium perchlorate titrant used
49.04	= equivalent weight of H_2SO_4.

$$d = \frac{Cm-Ct}{Ct} \times 100 \qquad (22)$$

where

d	= % difference
Cm	= measured concentration
Ct	= true concentration.

Comments were placed on the control chart when a new batch of standards was made up or a new reagent was used. The fourth control chart was a range chart for the $Ba(ClO_4)_2$ normality. The normality of the $Ba(ClO_4)_2$ solution being used was checked periodically and the difference from the original value calculated. This percent difference was plotted in the same manner as above. Interpretation of the quality control charts is discussed under Quality Control and Assurance.

K. Collection and Analysis For NO_x

1. Preparation of NO_x Flasks Prior To Sampling: Flasks and stopcocks were rinsed with deionized (DI) water. The stopcock was carefully checked to make sure the sleeve was in good shape and intact. Excess water was drained from the flask and stopcock. Stopcock glass joints were slightly greased with a chlorofluorocarbon-based stopcock grease, (e.g., Halocarbon grease).

SO_2 QUALITY ASSURANCE SAMPLES

Date Analyzed _____

Analyst _____

Titrant _____

Titrant Solution I. D. # _____

Normality of Titrant _____

Sample No.	Ml of Titrant Used			Volume of Aliquot	True Mg	Calculated Mg	0/0 Difference
	1	2	Avg.				

FIGURE IV-46. SO_2 QUALITY ASSURANCE SAMPLES

2. Sample Collection: Barometric pressure (uncorrected) was recorded. Twenty-five ml of freshly prepared NO_x absorbing solution was pipeted into a sampling flask. A sufficient quantity of absorbing solution was retained for preparing at least three standards and a blank for each twelve samples collected, i.e., at least 125 ml for each twelve samples.

The sampling probe was placed at a point between one-third and two-thirds into the stack. The sample train was assembled as shown in Figure IV-47. It is advisable to make the connections between the probe and flask as short as possible. The procedure outlined below was then followed:

Zeroed the manometer.

With manometer valve shut and pump valve open (Figure IV-48) and stopcock in P position (Figure IV-48), pump started.

Shut pump valve and opened manometer valve, then set stopcock in E position (Figure IV-48).

Opened pump valve and evacuated flask to 3 inches Hg absolute pressure or less (approximately 24 inches on mercury manometer).

Shut pump valve and checked manometer for fluctuation in mercury level (this leak checked the sample train between manometer and flask). If the fluctuation was greater than 0.4 inches Hg per minute, the leak rate was unacceptable and was changed.

If leak rate was zero or acceptable, initial temperature (T_i) and pressure (P_i) of the flask was recorded and stopcock set to P position. If the time between leak check and sampling was greater than one minute, then the flask pressure was re-checked just prior to sampling.

Pump valve opened and sample train purged. If condensation in the sample line was evident during purging, then the line between the stack and flask was heated by using a blow dryer.

Pump valve shut and when ready to sample, stopcock set in S position (Figure IV-48); sample pulled for approximately 20 seconds.

Stopcock set in P position, being extremely careful not to disengage stopcock from flask; flask disconnected from the sampling train and shaken continuously for 5 minutes.

3. Sample Recovery: After allowing the sample flasks to set for a minimum of 16 hours, each flask was shaken for at least 2 minutes. Barometric pressure was recorded (P_{bar}), as well as each flask temperature (T_f) and pressure (P_f), using the NO_x Sampling Data Form in Figure IV-49. Flask contents were transferred to a collection bottle and the flask and stopcock were rinsed with at least two 10-ml portions of DI water. The rinse water was added to the collection bottle. A blank, consisting of 25 ml NO_x absorbing solution and approximately the same amount of DI water used for rinsing each flask and stopcock was prepared. To each collection bottle, 1N sodium hyroxide (30-50 drops) was added until just basic to litmus paper (pH approximately 9-12) and then was checked by dipping a clean stirring rod into the solution and touching it to the litmus or pH paper. The collection bottle level was marked to determine any leakage between time of sample recovery and analysis. At least 100 ml of NO_x absorbing solution was retained for each twelve samples that were recovered. This was used in preparing NO_x standards during analysis. Each container was labeled to clearly identify its contents. Finally, each container was sealed with plastic tape.

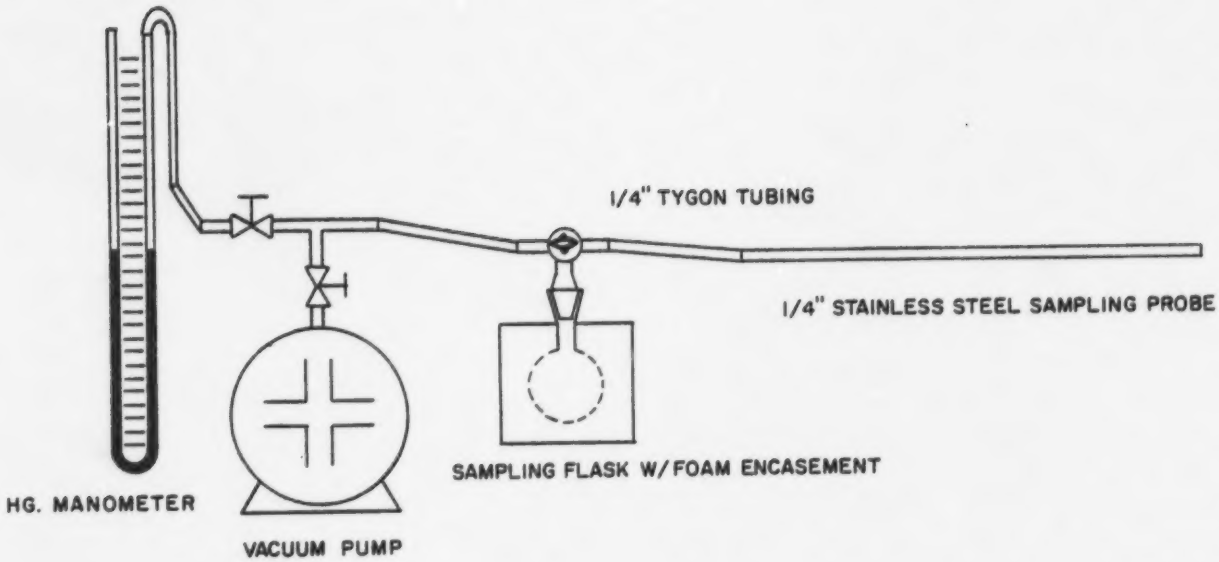


FIGURE IV-47. NO_x SAMPLING TRAIN

FIGURE IV-48. FLASK STOPCOCK POSITIONS

NO_x SAMPLING DATA

EPA METHOD 7

Plant/Location _____ Sample Date _____

Purpose _____

Pbar Uncorrected _____ in. Hg Temp. _____ °F

Sample #	Time	Flask No.	Leak Rate	Pi in. Hg	Ti F	Pf in. Hg	Tf F	Comments	Orast
									Leak Ck
									Time
									CO_2
									O_2
									Leak Ck.
									Time
									CO_2
									O_2
									Leak Ck.
									Time
									CO_2
									O_2

Sample Recovery Date _____

Pbar Uncorrected _____ in. Hg Temp. _____ °F

Sampled by _____

Recovered by _____

Check to see that the following have been done at the time of recovery.

- ☐ 1. Levels marked on containers
- ☐ 2. Labels on containers filled out completely
- ☐ 3. Container sealed for shipment

FIGURE IV-49. NO_x SAMPLING DATA FORM

4. Sample Analysis: The level in each collection bottle was noted and an indication was made on the analysis sheet (Figure IV-50) if any sample was lost during shipment and storage. Three standards were prepared to be run with each set of analyses. A 500 ug (low range), 1000 ug (mid range), and 1750 ug (high range) NO_2 standard was prepared in the following manner:

500 ug NO_2 standard	1000 ug NO_2 standard	1750 ug NO_2 standard
Added 20 ml KNO_3 "working standard solution" to an evaporating dish. . .	Added 40 ml KNO_3 "working standard solution" to an evaporating dish. . .	Added 80 ml KNO_3 "working standard solution" to an evaporating dish. . .

. . . .then pipeted 25 ml NO_x absorbing solution into each evaporating dish." The standard was diluted with deionized water to the same volume as each sample collection bottle and then added 1N sodium hydroxide, dropwise, until each standard solution was just basic to litmus (pH approximately 9-12).

The contents of each sample collection bottle was transferred into an evaporating dish and each bottle was rinsed twice with 5 ml portions of DI water. The following steps were then taken.

Evaporated each solution, including freshly prepared standards, to dryness over a steam bath; removed, and allowed to cool.

Added 2 ml phenoldisulfonic acid to each and tritrated thoroughly with a glass rod or polyethylene policeman. (Made sure acid contacted all of residue.)

Added 1 ml DI water and four drops of concentrated sulfuric acid.

Heated each solution over a steam bath for three minutes with occasional stirring; removed, and allowed to cool.

Added 10 ml DI water and mixed well by stirring.

Added 15 ml of fresh, concentrated ammonium hydroxide dropwise to excess (pH approximately 10.0). Checked pH of at least one sample with pHydrion paper to assure that a pH of 10.0 is being attained.

Filtered each solution into a 250 ml volumetric flask. Rinsed each evaporating dish thoroughly with DI water, also filtering each rinse. Washed all color completely from each filter into the corresponding 250 ml volumetric flask and diluted to the mark with DI water.

Mixed each flask solution well.

Read and recorded on analysis sheet the percent transmittance of each sample against a blank at 420 nm on a spectrophotometer.

Converted the photometric reading to ug NO_2 by means of the calibration curve and recorded on analysis sheet.

L. Calculation of Final Results

The System Lab used a computer program from its file to calculate the dry gas volume at standard conditions (V_{sc}); concentration of NO_x in lb/dscf (C); concentration of NO_x in ppm dry; and concentration in lb/10^6 Btu. A file copy of the program can be found in Table IV-11.

The program uses the following formulas to calculate the results.

FIGURE IV-50. NO_x ANALYSIS FORM

NO_x ANALYSIS

Date _____

Plant _____

Purpose _____

Sample Date _____

Pbar Uncorrected _____ in. Hg Temp. _____ °F

Pbar Corrected _____ in. Hg

Sample Recovery Date _____

Pbar Uncorrected _____ in. Hg Temp. _____ °F

*Pbar Corrected _____ in. Hg

Was there any loss of sample in transport? Yes____ No____

If yes, which containers _____

Analysis #	Sample #	Time	Flask #	Volume	Pf in. Hg	Tf °R	Pi in. Hg	Ti °R	% Trans	ug	Vsc l	10^{-5} C lb/dscf	ppm dry

*Pressure corrected for Temp. and Elevation

```
0001          DIMENSION PLANT(4),SAMDAT(4),ITEMP(2),SAMLO(3),
             &TITLE(4,4)
0002          DATA BLANK/'    '/
0003       30 CONTINUE
0004          READ (5,100,END=999) F,NSAMP
0005      100 FORMAT (8X,F5.0,7X,I2)
0006          WRITE(6,104)
0007      103 FORMAT(1H-,36X,'NOX',11X,'NOX',
             &/13X,'VSC', 9X,'C',10X,'PPM DRY',4X,
             &'LB/10**6BTU',6X,'RUN #')
0008      104 FORMAT(1H1,25X,'SOUTHWESTERN PUBLIC SERVICE CO.',
             &/35X, 'SYSTEM LAB',/8X,
             &23X,'OXIDES OF NITROGEN')
0009          WRITE(6,103)
0010        2 CONTINUE
0011          TC = 0.
0012          TPPM = 0.
0013          TPDBTU = 0.
0014          DO 3 I=1,NSAMP
0015          READ (5,101) J,VF,PF,TF,PI,TI,AM,O2
0016      101 FORMAT (3X,A4,4X,F5.0,5X,F5.2,5X,F4.0,5X,F5.2,
             &5X,F4.0,5X,F6.1,2X,F4.1)
0017          VSC=17.65*(VF-25.)*((PF/TF)-(PI/TI))
0018          C = 0.000062*AM/VSC
0019          PPM = C * 10.**9./(2.59*46.01)
0020          PDBTU = C * F * 20.9/(20.9 - O2)
0021          WRITE(6,102) VSC,C,PPM,PDBTU,J
0022      102 FORMAT(//10X,F8.2,2X,F10.7,4X,F8.2,6X,F8.6,8X,A5)
0023          TC = TC + C
0024          TPPM = TPPM + PPM
0025          TPDBTU = TPDBTU + PDBTU
0026        3 CONTINUE
0027          AC = TC / NSAMP
0028          APPM = TPPM / NSAMP
0029          APDBTU = TPDBTU / NSAMP
0030          WRITE(6,105)
0031      105 FORMAT(1H ,20X,'----------',
             &5X,'--------',5X'--------')
0032          WRITE(6,106)AC,APPM,APDBTU
0033      106 FORMAT(1H ,4X,'AVERAGE',8X,F10.7,4X,F8.2,6X,F8.6)
0034          READ(5,100)F,NSAMP
0035          IF(F.NE.0.)GO TO 2
0036          READ(5,108)PLANT(1),PLANT(2),PLANT(3),UNITNO,SAMLO(1),SAMLO(2),
             &SAMLO(3),SAMDAT(1),SAMDAT(2),
             &UTLOAD,SAMDAT(3),SAMDAT(4)
0037      108 FORMAT(5X,3A4,9X,A4,15X,3A4,
             &/12X,2A4,11X,A4,
             &/20X,2A4)
0038          WRITE(6,109)PLANT(1),PLANT(2),PLANT(3),PLANT(4),UNITNO,
             &SAMDAT(1),SAMDAT(2),
             &UTLOAD,SAMDAT(3),SAMDAT(4)
0039      109 FORMAT(///,5X,'PLANT',4A4,'STACK NO',A4,
             &/5X,'SAMPLE DATE ',2A4,' UNIT LOAD',A4,'MW',
             &/5X,'SAMPLE  RECOVERY DATE ',2A4,
             &///31X,'--------------------------',
             &/36X,' ANALYZED BY')
0040          GO TO 30
0041      999 STOP
0042          END
```

TABLE IV-ii. PROGRAM FOR METHOD 7 CALCULATIONS

NO_x CALCULATIONS

$$V = (17.64 \frac{°R}{in.\ Hg})\ (V_f - 25\ ml)\left(\frac{P_f}{T_f}\ \frac{P_i}{T_i}\right) \qquad (23)$$

where

V_{sc} = Sample volume at standard conditions (dry basis), ml
V_f = Volume of flask and valve, ml
P_f = Final absolute pressure of flask, inches Hg
P_i = Initial absolute pressure of flask, inches Hg
T_f = Final absolute temperature of flask, °R
T_i = Initial absolute temperature of flask, °R

$$17.64 = \frac{\text{Temperature standard}}{\text{Pressure standard}} = \frac{(528\ °R)}{29.92\ in.\ Hg.}$$

$$C = (6.2 \times 10^{-5} \frac{lb/scf}{ug/ml})\ (\frac{m}{V_{sc}}) \qquad (24)$$

where

C = Concentration of NO_x as NO_2 (dry basis) lb scf
m = Mass of NO_2 in gas samples, ug
V_{sc} = Sample volumes at standard conditions (dry basis), ml.

NO_x CALCULATIONS

To convert the concentration of NO_x in lb/dscf to lb/10^6 Btu, the following formula from 60.45e (1) was used:

$$E = CF \frac{20.9}{20.9 - \%O_2} \qquad (25)$$

where

E = lb/10^6 Btu
C = lb/dscf
F = F factor as calculated in 40 CFR 60.45f (5).

To convert C, the concentration of NO_x as NO_2 (dry basis, in lb/scf to parts per million), use the following:

$$PPM = C * 8.391662 * 10^6 \qquad (26)$$

1. Reagents For NO_x Test:

NO_x Absorbing Solution: diluted 3 ml concentrated sulfuric acid to 1 liter with DI water. Mixed well. Added 3 ml 30 percent H_2O_2. Did not expose to heat or direct sunlight.

1 N Sodium Hydroxide: dissolved 42 grams NaOH in distilled water and diluted to 1 liter.

Phenoldisulfonic Acid: dissolved 25 grams pure white phenol in 150 ml concentrated sulfuric acid on a steam bath. Cooled, added 75 ml fuming sulfuric acid and heated at 100°C for two hours. Stored in a dark, glass-stoppered bottle.

Potassium Nitrate Standard Solution: dried potassium nitrate (KNO_3) at 105° to 110°C for two hours and cooled in a desiccating chamber. Dissolved 0.5495 grams KNO_3 in distilled water and diluted 1 liter in a volumetric flask. For a working standard, diluted 10 ml to 100 ml with water to obtain the working standard of 25 ug/ml (.025 mg/ml).

Using 10 ml of working standard yielded 250 ug NO_2 (.25 mg NO_2); other amounts equaled the following:

20 ml	yielded	500 ug NO_2	(.50 mg NO_2).
30 ml	yielded	750 ug NO_2	(.75 mg NO_2).
40 ml	yielded	1000 ug NO_2.	
50 ml	yielded	1250 ug NO_2.	
60 ml	yielded	1500 ug NO_2.	
70 ml	yielded	1750 ug NO_2.	
80 ml	yielded	2000 ug NO_2.	
90 ml	yielded	2250 ug NO_2.	
100 ml	yielded	2500 ug NO_2.	
110 ml	yielded	2750 ug NO_2.	
120 ml	yielded	3000 ug NO_2.	

M. Calibrations and Standardizations

1. Flask Volume: The volume of the collection flask was determined prior to sampling. To do this, the flask and stopcock assembly were filled with water. Then the volume of water contained in the flask was measured and recorded to ±10 ml.

2. Spectrophotometer: Calibration of the wavelength scale on the photometer was done under any of the following conditions:

If there was any replacement of parts such as lamps, etc., on the photometer.

If it had been six months since the last time it was checked.

The calibration procedure involved the drawing of a curve with transmittance versus wavelength. The System Lab maintained a set of solutions to be used for these wavelength checks. The instructions provided with the standard solutions were followed in drawing up these graphs. All of the data collected for wavelength checks and maintenance records were kept in an instrument quality control record book.

3. Quality Assurance: Three control charts were maintained to assure the quality of the data reported for NO_x determinations (see Figure IV-51). One control chart was set up for each of the three standard solutions used. Each chart plotted the results of the standard sample versus the date of analysis. The results of the analysis of the standard sample were plotted as percent difference from the true value.

ANALYSIS OF STANDARDS FOR NO_x

QUALITY ASSURANCE

Analyst	Date of Analysis	Analysis #	Standard Aliquot (ml)	Standard (μm)	Actual % Transmittance	Actual (μm)	Curve # for Trans. Vs. μg	Date of Curve	Date in which Phenoldisulfonic Acid Prepared	Comments

FIGURE IV-51. ANALYSIS OF STANDARDS FOR NO_x

The percent difference was calculated using the following formula:

$$d = \frac{C_m - C_t}{C_t} \times 100 \qquad (27)$$

where
d = % difference
C_m = measured concentration
C_t = true concentration.

Comments were placed on the control chart when a new batch of standards was made up or a new reagent was used. Interpretation of the quality control charts is discussed under Quality Control and Assurance.

H. Quality Control and Assurance

This section deals with the mechanics of drawing up a quality control chart and how to use the chart to assure good quality data. The criteria for field equipment is also presented.

The performance criteria necessary for equipment used in sampling for particulate, SO_2, and NO_x are listed in Tables IV-III, IV-IV, and IV-V. These criteria were adhered to in purchasing and calibrating equipment for the special test program, eliminating large undetected bias in sampling and analysis.

Control charts were used in SO_2 and NO_x analyses to verify and document the quality of the data collected. The percent difference from a standard value or an original value was plotted against time. The upper and lower control limits were either calculated using the standard deviation as a basis or were assigned a value from literature on the subject.

There were two types of control charts for SO_2 analysis. The first type involved the measurement of standard SO_2 samples. The value obtained on each standard was used to calculate the percent d; this value was then plotted on separate charts for each standard. The second type of control chart was used to assure a consistent quality of barium perchlorate to titrate with. Before each set of analysis, the barium perchlorate normality was checked with standard sulfuric acid and then the percent d from the original value was calculated and plotted. Both of the control charts for SO_2 had 5 percent control limits until enough data was obtained to develop other limits. This limit is suggested in the "Guidelines For Development of a Quality Assurance Program: Volume V - Determination of Sulfur Dioxide Emissions From Stationary Sources" (3).

Table IV-III: Suggested Performance Criteria

For Particulate Sampling Equipment

Dry Gas Meter	Calibration factor between 0.98 and 1.02.
Thermometers and Temperature Gauges	Capable of measuring 1°C or 2°F intervals; must agree within 1.5% of the absolute temperature as measured by a standard in-glass mercury thermometer.
Stack Temperature Measuring System	Digital pyrometer with chromel-alumel thermocouple; must agree within 1.5% of the absolute temperature as measured by a standard in-glass mercury thermometer.
Sampling Train Leakage.	Less than 0.02 $ft.^3$/minute at 15-inch Hg.
Sample Box Heater	Capable of maintaining a temperature of 250°F ± 25°F at laboratory conditions.
Probe Heating System	Capable of reaching and maintaining a temperature of 250°F ± 25°F at lab conditions inside the probe in approximately 30 minutes.
Magnehelic	Capable of reading within 5% of an incline gauge oil manometer.
Probe Nozzle Diameter	Range of three different diameter measurements less than 0.010 cm.
Analytical Balance	Weigh a standard weight within ± 0.3 mg. of its stated weight.

Table IV-IV. Suggested Performance Criteria

For SO_2 Sampling Equipment

Dry Gas Meter	Calibration factor between 0.98 and 1.02.
Thermometers and Temperature Gauges	Capable of measuring 1°C or 2°F intervals; must agree within 1.5% of the absolute temperature as measured by a standard in-glass mercury thermometer.
Stack Temperature Measuring System	Digital pyrometer with chromel-alumel thermocouple; must agree within 1.5% of the absolute temperature as measured by a standard in-glass mercury thermometer.
Sampling Train Leakage	1% of sampling flow rate at 10-inch Hg.
Probe Heating System	Capable of reaching and maintaining a temperature of 250°F ± 25°F at lab conditions inside the probe in approximately 30 minutes.

Table IV-V. Suggested Performance Criteria

For NO_x Sampling Equipment

Thermometers and Temperature Gauges	Capable of measuring 1°C or 2°F intervals; must agree within 1.5% of the absolute temperature as measured by a standard in-glass mercury thermometer.
U-Tube Manometer	36-inch mercury manometer with 0.1-inch divisions.
Flask Volume	Known within ± 10 ml.
Spectrophotometer	Wavelength should check out to within ± 5 nm.

For NO_x analysis, a control chart similar to the standard chart for SO_2 was used. The percent d was calculated and plotted against time. The control limits were arbitrarily set at 12 percent. After a sufficient number of analyses were run, the standard deviation was calculated, then the control limit was set at three times the standard deviation.

Drawing and maintaining control charts is not good enough to assure high quality data. Action must be taken to correct situations when the procedure is out of control. The following list indicates the criteria SPS used to recognize a process out of control.

One point fell outside the upper or lower control limit.

Two consecutive points fell between the warning and control limits.

Three consecutive points fell outside the standard deviation range.

The System Lab also participated in the Stationary Source Quality Assurance Survey conducted by the EPA. The results of these standard analysis are kept on file as a part of the quality assurance program for SO_2, NO_x, and particulate analysis. The form used by the System Lab for the particulate survey is included here (Figure IV-52).

Method 5 Dry Gas Meter
Inter-Laboratory Survey

Date_____ Calibrated By_____

Dry Gas Meter Correction Factor_____ Barometric Pressure_____

in H_2O (ΔH)	DG_i (ft^3)	DG_f (ft^3)	T_{in_i} (°F)	T_{out_i} (°F)	T_{in_f} (°F)	T_{out_f} (°F)	Amb. Temp. Initial	Amb. Temp. Final	Vac. in. Hg	Time minutes	Pbar	Run No.

FIGURE IV-52. METHOD 5 DRY GAS METER INTER-LABORATORY SURVEY

V. SPS TEST PHASES AND RESULTS

A. Phase I

During the week of December 11-15, 1978, SPS performed the first series of tests to measure mass emissions of particulate, sulfur dioxides, and oxides of nitrogen. The original work plan called for simultaneous sampling at five locations; however, procurement problems with equipment prohibited completion of the outlet sampling trains. For particulate and SO_2 samples it was believed the test would result in better quality data if only three stations (both inlets and the stack) were sampled. The sampling procedure for oxides of nitrogen required less manpower and equipment than sampling for SO_2 and particulate; therefore, sampling for NO_x was performed at all five locations (two inlet, two outlet, one stack).

A crew of test personnel from SPS power plants was assembled at Harrington Station for the first week-long series of tests. Approximately 26 stack sampling team members participated in the program. SPS organized a stack sampling manual for personnel assigned to the special testing phases. By taking samples at three locations rather than five, experienced personnel were able to work with the less experienced ones. As a result, personnel at all the sampling locations had some degree of experience during the remaining tests.

The results of the first inlet testing compare favorably with the theoretical inlet grain loading (the theoretical inlet grain loading is estimated and based upon generation of 70 percent fly ash). The percent fly ash has never been accurately determined but has been estimated to be between 70 and 80 percent.

During the Phase I test, the heater on the Inconel probe being used at the stack location failed. It was later determined that condensation forming in the probe contributed additional particulates to the probewash; this solution was greenish in color. It was later analyzed and determined to be high in nickel. The conclusion was that the acid moisture reacted with the probe and thereby biased the test result. These conditions were corrected for the second series of tests. The results of the NO_x tests were very consistent across the baghouse. Results of the sulfur dioxide tests on the stack compare favorably with the stoichiometric calculation for sulfur dioxide. SO_2 measurements at inlet locations were erratic due to high negative duct pressure.

Analyses of the Phase I special tests are shown in Table V-I. Results confirmed that Unit 2 can operate in compliance with the existing New Source Performance Standard of .1 $lb/10^6$ Btu. However, problems in the testing with the unheated probe caused results to be biased (high). Concentrations of NO_x were determined to be consistent at all five sampling locations. As a result, SPS and EPA decided the testing program could be better managed by excluding NO_x from future testing. Field notes are included in Appendix C.

B. Phase II

The second series of special tests to be performed by SPS was initially scheduled for May, 1979. Due to a decision to rebag the fabric filter system, special testing was rescheduled for October 8-12, 1979.

In September of 1978, the Harrington Station baghouse began to experience a higher than normal failure of bags. Examination of the problem indicated that two items needed immediate attention: (1) the

Table V-I. Phase I Test Results

Results of Particulate Testing

Run #	East Inlet gr/SCF	West Inlet gr/SCF	Theoretical Inlet+ gr/SCF	Stack*** gr/SCF	Stack*** $lb/10^6$ Btu
1*	2.28	2.74	2.09	.053	.106
2*	2.04	2.26	1.96	.050	.097
3**	1.67	1.63	2.27	.033	.061

*sootblowing continuously

**not sootblowing

***The concentrations of particulate obtained from the stack are biased high because a reaction took place in the unheated Inconel probe liner.
+assumes 70% fly ash, 30% bottom ash and economizer ash; no consideration for sootblowing.

Results of NO_x Testing

Run #	East Inlet Method 7	East Outlet Method 7	West Inlet Method 7	West Outlet Method 7	Stack Method 7
1	.68	.64	.61	.62	.63
2	.71	.68	.59	.62	.66
3	.67	.71	.62	.62	.64

Results of SO_2 Testing

Run #	East Inlet* Method 6 $lb/10^6$ Btu	West Inlet* Method 6 $lb/10^6$ Btu	Stoichiometric $lb/10^6$ Btu	Stack Method 6 $lb/10^6$ Btu
1	.53	.36	.76	.73
2	.59	.32	.84	.78
3	.62	.20	.88	.84

*These concentrations are suspected of being low because of the high negative pressure pulling the absorbing solutions forward, thereby resulting in the absorbed SO_2 not being analyzed.

**Assumes all sulfur is converted to SO_2.

control of the deflation pressure during the cleaning cycle and (2) tension on the bag. By October, a program had begun to redesign the deflation pressure control system and bags were re-tensioned.

SPS then became concerned about the accelerated rate of bag failures occurring in the Unit 2 baghouse. These failures were of two types; small pinhole-type failures near the bottom cuff, and failures described as "blowouts" where a whole section of the bag would burst and fray. Based on information derived from an in-house fabric assessment program and an EPA mobile baghouse study, SPS decided to rebag the entire baghouse with new fabrics before the 1979 summer peak. The west baghouse was rebagged June 16, 1979 and the east on June 30, 1979. Figure V-I shows the types of fabrics used to rebag the baghouse.

Another adjustment that resulted from the EPA mobile baghouse study was resetting the cleaning cycle and increasing the frequency of shake on two compartments. The adjustment in frequency of shake was accomplished by changing the size of the shaker's drive mechanism pulley.

A relative flow comparison between compartments with a standard shake and an accelerated shake indicated much improvement in cleaning and pressure drop. Larger pulleys were placed in additional compartments and two problems resulted: (1) the limitation of shaker motor horsepower could not be exceeded and (2) the shaker pillow block system began to fail. It was determined that a 5.3-inch pulley in place of the 4.0-inch pulley provided enough frequency increase and was within horsepower limitations. The pillow block assemblies were redesigned and replaced before the second special test; no recent problems have been noted.

With these changes having been completed, SPS conducted the Phase II special testing in October, 1979. The experience gained in the first series of tests enabled SPS personnel to conduct tests at all five sample locations as originally specified by the EPA. Results of the Phase II testing are shown in Table V-II.

Data from the outlet sample locations were not of as good a quality as data from stack sample locations. This difference may be due to a poor outlet sampling location and an extra long port extension. It was very difficult to sample these locations without picking up material in the probe nozzle, and a very small quantity can significantly affect the results.

High negative pressure still affected the Phase II SO_2 measurements, although results were much improved over the first test. This problem was attributed to negative pressure pulling the absorbing solution forward in the sampling train.

C. Phase III

Southwestern's third special test was performed the week of March 24-27, 1980. Twenty SPS employees participated in the week-long test for SO_2 and particulate. A number of difficulties were encountered, causing several delays; however, it was felt that the testing was concluded in a successful manner.

Adjustments made to the baghouse prior to the Phase III testing included the following:

All of the west baghouse compartments were retensioned after several of them failed to shake. This problem was attributed to over-

WEST BAGHOUSE		EAST BAGHOUSE	
1 *	2 *	15 **	16 **
3 *	4 *	17 **	18 **
5 *	6 Menardi-Southern Teflon Test Bags	19 Original bags equipped with special shaker mechanism	20 Fabric Filters All-filament Teflon
7 1 Nomex All-Spun; 2 Nomex Comb. 5 Crisoflex 446; 4 Criso-flex 449 ***	8 *	21 Criswell 442 Teflon B Test Bags	22 34 Acid Flex; 34 Tri-Treat Balance: Original Bags
9 * (Warp In)	10 *	23 Fabric Filters 502 Tri-Treat Test Bags	24 Globe-Albany Nomex
11 *	12 *	25 Criswell 449 Teflon B Test Bags	26 **
13 *	14 *	27 **	28 **

*Criswell 442 Teflon B, 0.30kg (10.5 oz.) (rebagging complete).
**Criswell 449 Tri-Treat: 0.40kg (14 oz.) (rebagging complete).

FIGURE V-1. FABRIC INSTALLATION, JULY, 1979

Table V-II. Phase II Test Results

Results of Particulate Testing:

Run No.	East Inlet gr/scf	West Inlet gr/scf	Theo-retical gr/scf±	East Outlet gr/scf	West Outlet gr/scf	Stack gr/scf	Stack lb/10^6 Btu
1	1.40	1.41	1.64	.014	.012	.010	.020
2	1.61	1.41	1.64	.014	.024	.011	.021
3	1.61	.74*	1.69	.027	.028	.011	.022

Results of SO_2 Testing:

Run No.	East Inlet lb/10^6 Btu	West Inlet lb/10^6 Btu	Theo-retical lb/10^6 Btu	East Outlet lb/10^6 Btu	West Outlet lb/10^6 Btu	Stack lb/10^6 Btu
1	.71	.74	1.03	.70	.76	.79
2	.74	.79**	.95	.79	.82	1.01
3	.66	.71**	.99	.78	.78**	.96

± Based upon stoichiometric flue gas flow, coal flow, ash analysis and 70% fly ash generation and 30% bottom ash and economizer ash generation.

* One sample of probe wash was lost during transport from sample site to the lab, causing this sample to biased low.

** Based upon only one of two samples for this run.

tightening of turnbuckles attached to the shaker tube support member. These turnbuckles were installed during the October, 1979 annual over-haul to correct sagging problems. Apparently, they were over-tightened, which in turn over-tensioned the bags, resulting in an overload condition on the shaker motor.

During the month of March, three outlet damper drives had to be repaired. As in all previous outlet damper drive failures the brass nut had failed. In order to lengthen damper drive life, tests were performed to see if the damper drive stroke could be shortened without affecting the pressure drop across the outlet damper.

Results of the Phase III testing are shown in Table V-III. Several problems were encountered during the testing. Inlet testing teams had considerable problems with the fritted supporting disks breaking, causing the filters to tear. This accounts for the low grain loading experienced on the various runs. The last run at the stack location failed the leak test at the end of the run. SPS determined that a connector glassware clamping the hot box lost tension and leaked. A review of the raw data indicates this probably happened at the first point in the last port.

A review of the SO_2 results indicates that problems still existed with sampling the highly negative pressure ducts with the SO_2 impingers. Improvements in testing procedures had been made by the third test, but some problems still remained to be solved. These are itemized in Appendix C.

D. Phase IV

Maintenance and operation changes between the third and fourth special tests ranged from cleaning boiler slag out of the Unit 2 economizer and air preheaters to repairs to shaker tube flangette bearings. The bags in compartment 23 were changed out during April, due to multiple pinhole failures in the upper portion of the bags. In addition, seven shaker mechanisms were repaired in June.

During the Phase IV testing period in August, 1980, the baghouse encountered no major upsets or operating problems. All of the shakers were in service and operating in a normal fashion. The temperatures, flows and pressure drops encountered were all within normal operating limits.

The opacity, however, was higher than normal, being approximately 8 percent compared to 5 percent previously. (It is felt that this rise was due to bag bleeding in several compartments of test fabrics).

During the test period erratic opacity spikes were observed that seemed to correspond with the cleaning cycle of compartment 27. The compartment was left in service throughout the test awaiting more definite indications of failure since the opacity spikes did not follow the clean cut blowout pattern previously observed. On August 29, 1980 the compartment was removed from service and four blown bags and two other damaged bags were replaced.

Problems with sampling SO_2 at inlets were corrected and results were comparable to stack SO_2 (see Table V-IV).

E. SPS/GCA Test

A joint test was conducted by SPS and its subcontractor, GCA Corporation, on June 4, 5, and 6, 1980. SPS ran simultaneous tests for particulate and GCA tested for SO_3 and particle sizing.

Table V-III. Phase III Test Results

Results of Particulate Testing:

Run No.	East Inlet gr/scf	West Inlet gr/scf	Theoretical gr/scf**	East Outlet gr/scf	West Outlet gr/scf	Stack gr/scf	Stack lb/10^6 Btu
1	.*	*	1.82	.008	.012	.009	.017±
2	1.43	1.35	1.95	.013	.038	.013	.024
3	.97	1.14	2.03	.011	.022	.018	.032
4	.*	1.50	2.04	.007	.020	.024	.044±±

Results of SO_2 Testing:

Run No.	East Inlet lb/10^6 Btu	West Inlet lb/10^6 Btu	Theoretical lb/10^6 Btu	East Outlet lb/10^6 Btu	West Outlet lb/10^6 Btu	Stack lb/10^6 Btu
1	.76	.69	.82	.70	.68	.81
2	*	.67	.81	.69	*	.75
3	*	.67	.81	.65	*	.78

* No data

** Based upon stoichiometric flue gas flow, coal flow, ash analysis and 70% fly ash generation and 30% bottom ash and economizer ash generation; (dry basis).

± Not isokinetic

±± Failed leak check test

Table V-IV. Phase IV Test Results

Results of Particulate Test:

Run No.	East Inlet gr/scf	West Inlet gr/scf	Theoretical gr/scf**	Stack gr/scf	Stack lb/10^6 Btu
1	1.64	1.92	1.99	.016	.031
2	1.88	1.67	1.97	.009	.018
3	1.35	1.44	1.96	.015	.030

Results of SO_2 Test:

Run No.	East Inlet lb/10^6 Btu	West Inlet lb/10^6 Btu	Theoretical lb/10^6 Btu	Stack lb/10^6 Btu
1	.84	.76	.96	.84
2	.89	.79	.94	.95
3	.88	.78	.96	.83

** Based upon stoichiometric flue gas flow, coal flow, coal analysis and 70% fly ash generation (dry basis).

SPS testing began at 10:50 a.m. on June 4, 1980. No significant problems occurred during the testing. The east inlet probe liner slipped as the probe was being withdrawn from the duct. This caused the train to fail the leak check; however, it is not believed that results were significantly affected. The test concluded at about 12:30 p.m.

GCA began the impactor testing at the stack location at about 7:00 a.m. Goksoyr-Ross was run for 1 hour. No condensation occurred in the condenser coil indicating the low concentration of SO_3. A discussion with GCA indicated that a much longer run on the stack might give better resolution of SO_3. This was not predicted on the inlets because of the high grain loading of particulate. GCA also began the inlet impactor runs about 12:30 p.m. and expected to run until about 4:00 p.m.

No particular problems were experienced by SPS. The stack run blew two fuses while in the fourth port, which was noted on a data sheet and sampling time and volume were kept up. In order to collect a larger particulate sample, a larger nozzle was selected for the third run. This allowed a larger sample and minimized problems associated with verifying a small particulate sample. The baghouse experienced failures in the shaker mechanism.

The testing during these two tests were considered by SPS the most successful of any conducted during the program. The inlet particulate concentrations were not as consistent as desired which can be attributed to the lack of idealness in the sampling location. The inlet SO_2 emissions were consistent and compared very well with the stack results. Much difficulty was experienced with the highly negative duct pressure in previous tests. Results of the SPS/GCA test are shown in Table V-V.

Table V-V. Results of SPS/GCA Joint Test

Results of Particulate Test:

Run No.	East Inlet gr/scf	West Inlet gr/scf	Theoretical gr/scf**	Stack gr/scf	Stack lb/10^6 BTU
1	*	2.30	2.13	.015	.032
2	1.92	1.86	2.22	.019	.037
3	1.38	1.31	1.95	.008	.016

*Invalid test

**Based upon stoichiometric flue gas flow, coal flow, coal analysis and 70% fly ash generation (dry basis).

VIII. REFERENCES

1. Ladd, K. L., Faulkner, G. R. and Kunka, S. L., "Fabric Filter System Study: First Annual Report", EPA-600/7-79-183, August 1979.

2. Ladd, K. L., Chambers, R. C., Plunk, O. C., and Kunka, S. L., "Fabric Filter System Study: Second Annual Report", prepared under EPA Contract No. 68-02-2659, August 1980.

3. "Guidelines For Development of a Quality Assurance Program: Volume V - Determination of Sulfur Dioxide Emissions From Stationary Sources."

Appendix A

Coal Analysis

P-464

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

WESTERN DIVISION MANAGER
LLOYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 31st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772

SOUTHWESTERN PUBLIC SERVICE COMPANY
P.O. Box 1261
Amarillo, Texas 79170

January 12, 1979

		Sample identification by
Kind of sample reported to us	Coal	Southwestern Public Service Co.
Sample taken at	Harrington Station	Sample No. 30 Feeder A - E Air Dried 18 hours % ADL = 18.00
Sample taken by	Southwestern Public Service Co.	Charge Account #606-1501.0402
Date sampled	12-14-78	P. O. No. 766-060F
Date received	1-4-79	

Analysis report no. 72-80117

PROXIMATE ANALYSIS	As Received	Dry Basis
% Moisture	29.20	xxxx
% Ash	5.62	7.94
% Volatile	31.63	44.68
% Fixed Carbon	33.55	47.38
	100.00	100.00
Btu	8437	11916
% Sulfur	0.30	0.42

ULTIMATE ANALYSIS	As Received	Dry Basis
% Moisture	29.20	xxxx
% Carbon	49.03	69.25
% Hydrogen	3.45	4.87
% Nitrogen	0.76	1.07
% Chlorine	0.01	0.01
% Sulfur	0.30	0.42
% Ash	5.62	7.94
% Oxygen (diff)	11.63	16.44
	100.00	100.00

cc: Ken Lindemann
Jerry Hermesmeyer
Royce Kelly
Steve Jones
Charles Bagwell
Morris Rantz
Olon Plunk

REPRESENTATIVE COAL ANALYSIS
PHASE I

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

G. D. PALMER, Manager, Denver Laboratory

Charter Member

GDP/md /pm

Original Copy Watermarked For Your Protection

BILLINGS, MT • BIRMINGHAM, AL • CHARLESTON, WV • CLARKSBURG, WV • CLEVELAND, OH • DENVER, CO • GOLDEN, CO • HENDERSON, KY • JASPER, AL
MIDDLESBORO, KY • MOBILE, AL • NEW BETHLEHEM, PA • NEW ORLEANS, LA • NORFOLK, VA • PALISADES, CO • PIKEVILLE, KY • RD. HOLLAND, IL • VANCOUVER, B.C. CAN.

F 464

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-6434

WESTERN DIVISION MANAGER
LLOYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 51st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772

SOUTHWESTERN PUBLIC SERVICE COMPANY
P.O. Box 1261
Amarillo, Texas 79170

November 27, 1979

		Sample identification by
Kind of sample reported to us	Coal	Southwestern Public Service Co.
Sample taken at	xxxxx	Sample No. 45
Sample taken by	Southwestern Public Service Co.	% Air Dry Loss = 10.38 Composite Baghouse
Date sampled	10-11-79	Charge Account # 606-1501.0402 P.O. No. 15326-75
Date received	11-1-79	

Analysis report no. 72-88356

PROXIMATE ANALYSIS	As Received	Dry Basis
% Moisture	26.91	xxxx
% Ash	4.69	6.42
% Volatile	32.44	44.38
% Fixed Carbon	35.96	49.20
	100.00	100.00
Btu	8850	12108
% Sulfur	0.36	0.49

ULTIMATE ANALYSIS	As Received	Dry Basis
% Moisture	26.91	xxxx
% Carbon	51.32	70.21
% Hydrogen	3.71	5.08
% Nitrogen	0.65	0.89
% Chlorine	0.01	0.01
% Sulfur	0.36	0.49
% Ash	4.69	6.42
% Oxygen (diff)	12.35	16.90
	100.00	100.00

cc: Steve Jones
Ken Lindemann
Olon Plunk
Ronnie Blythe
Steve Thurman

REPRESENTATIVE COAL ANALYSIS
PHASE II

RECEIVED
NOV 30 1979
SYSTEM LAB

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

G. D. PALMER, Manager, Denver Laboratory

Charter Member

GDP/md/vt
Original Copy Watermarked For Your Protection

F-464

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 AREA CODE 312 726-8434

WESTERN DIVISION MANAGER
LLOYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 51st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772

SOUTHWESTERN PUBLIC SERVICE COMPANY
P.O. Box 1261
Amarillo, Texas 79170

April 25, 1980

		Sample identification by
Kind of sample reported to us	Coal	Southwestern Public Service Co.
Sample taken at	xxxxx	Sample No. 71
Sample taken by	Southwestern Public Service Company	% ADL = 10.37
Date sampled	3-27-80 (2,3,4,5 p.m.)	
Date received	4-15-80	

Analysis report no. 72-92452

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	27.27	xxxx
% Ash	4.98	6.85
% Volatile	32.46	44.63
% Fixed Carbon	35.29	48.52
	100.00	100.00
Btu	8840	12155
% Sulfur	0.35	0.48

ULTIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	27.27	xxxx
% Carbon	51.45	70.74
% Hydrogen	3.42	4.70
% Nitrogen	1.04	1.43
% Chlorine	0.01	0.01
% Sulfur	0.35	0.48
% Ash	4.98	6.85
% Oxygen (diff)	11.48	15.79
	100.00	100.00

cc: Ken Lindemann
Ronald Blythe
Steve Jones
Olon Plunk
Leo Fajardo

REPRESENTATIVE COAL ANALYSIS
PHASE III

RECEIVED
APR 30 1980
SYSTEM LAB

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

G. D. PALMER, Manager, Denver Laboratory

GDP/md/jh

Original Copy Watermarked For Your Protection

Charter Member

F-464

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-6434

WESTERN DIVISION MANAGER
[redacted]
GAIL D. PALMER

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 51st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772

SOUTHWESTERN PUBLIC SERVICE COMPANY
P.O. Box 1261
Amarillo, Texas 79170

September 8, 1980

Kind of sample reported to us	Coal	Sample identification by: Southwestern Public Service Co.
Sample taken at	xxxxx	Sample No. 3 Time: 3:20 pm & 4:30 pm Moisture Loss = 17.41%
Sample taken by	Southwestern Public Service Co.	P. O. No. 15975-673
Date sampled	8-26-80	
Date received	9-2-80	

Analysis report no. 72-97065

PROXIMATE ANALYSIS	As Received	Dry Basis
% Moisture	27.64	xxxx
% Ash	4.94	6.83
% Volatile	32.00	44.23
% Fixed Carbon	35.42	48.94
	100.00	100.00
Btu	8763	12110
% Sulfur	0.42	0.58

ULTIMATE ANALYSIS	As Received	Dry Basis
% Moisture	27.64	xxxx
% Carbon	50.50	69.79
% Hydrogen	3.60	4.98
% Nitrogen	0.72	1.00
% Chlorine	0.01	0.02
% Sulfur	0.42	0.58
% Ash	4.94	6.83
% Oxygen (diff)	12.17	16.80
	100.00	100.00

cc: Ken Lindemann
Ronnie Blythe
Steve Jones
Dean Metcalf
Olon Plunk

REPRESENTATIVE COAL ANALYSIS
PHASE IV

RECEIVED
SEP 11 1980
SYSTEM LAB

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Gail D. Palmer

G. D. PALMER, Manager, Denver Laboratory

Charter Member

GDP/md/pm

Original Copy Watermarked For Your Protection

BILLINGS, MT • BIRMINGHAM, AL • CHARLESTON, WV • CLARKSBURG, WV • CLEVELAND, OH • COHOCTON, OH • DENVER, CO • GOLDEN, CO • HELPER, UT • HENDERSON, KY • HOUSTON, TX • JASPER, AL
MIDDLESBORO, KY • MOBILE, AL • NEW BETHLEHEM, PA • NEW ORLEANS, LA • NORFOLK, VA • PALISADE, CO • PIKEVILLE, KY • SALINA, UT • SO. HOLLAND, IL • TOLEDO, OH • VANCOUVER, B.C. CAN.

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

WESTERN DIVISION MANAGER
LLOYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 51st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772

SOUTHWESTERN PUBLIC SERVICE COMPANY
P.O. Box 1261
Amarillo, Texas 79170

July 21, 1980

Sample identification by

Kind of sample reported to us	Coal	Southwestern Public Service Company
Sample taken at	xxxxx	Composite Baghouse - Sample 75
Sample taken by	Southwestern Public Service Company	P. O. No. 15863-75 % ADL = 12.57 (Reported by SWPS CO.)
Date sampled	6-5-80	
Date received	7-8-80	

Analysis report no. 72-94929

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	26.96	xxxx
% Ash	5.30	7.25
% Volatile	31.52	43.16
% Fixed Carbon	36.22	49.59
	100.00	100.00
Btu	8774	12012
% Sulfur	0.42	0.57

ULTIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	26.96	xxxx
% Carbon	50.37	68.96
% Hydrogen	3.70	5.07
% Nitrogen	0.77	1.06
% Chlorine	0.00	0.00
% Sulfur	0.42	0.57
% Ash	5.30	7.25
% Oxygen (diff)	12.48	17.09
	100.00	100.00

cc: Ken Lindemann
Ronald Blythe
Environmental Group
Steve Jones
Joe Don Parrott

REPRESENTATIVE COAL ANALYSIS
SPS/GCA

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Gail D. Palmer

G. D. PALMER, Manager, Denver Laboratory

Charter Member

GDP/md/jh

Original Copy Watermarked For Your Protection

Appendix B

Raw Field Data

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 2 12/11/78 16:38:36

1 INLET PART LOADING EAST
2 INLET PART LOADING EAST
3 INLET PART LOADING WEST
4 INLET PART LOADING WEST
5 OUTLET PART LOADING EAST
6 OUTLET PART LOADING EAST
7 OUTLET PART LOADING WEST
8 OUTLET PART LOADING WEST
9 PART REMOVAL EFF EAST
10 PART REMOVAL EFF WEST
11 INLET SO2 EAST 1 HR AVG
12 INLET SO2 EAST 1 HR AVG
13 INLET SO2 WEST 1 HR AVG
14 INLET SO2 WEST 1 HR AVG
15
16
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU
1:00	19.0	2.00	19.0	2.00	19.0000	1.9999	19.0000	1.9999	0.000	*00.000	*303.91	*0.60	375.04	*0.88
2:00	19.0	4.00	19.0	4.00	19.0000	3.9999	19.0000	3.9999	0.000	*00.000	*318.50	*0.63	375.30	*0.91
3:00	19.0	6.00	19.0	6.00	19.0000	9.9998	19.0000	9.9998	0.000	*00.000	*316.90	*0.63	375.30	*0.93
4:00	19.0	2.00	19.0	2.00	19.0000	1.9998	19.0000	1.9998	0.000	*00.000	*316.02	*0.63	375.46	*0.93
5:00	19.0	4.00	19.0	4.00	19.0000	3.9997	19.0000	3.9999	0.000	*00.000	*312.23	*0.62	374.84	*0.93
6:00	19.0	4.00	19.0	4.00	19.0000	3.9999	19.0000	3.9999	0.000	*00.000	*312.74	*0.62	375.12	*0.93
7:00	19.0	4.00	19.0	4.00	19.0000	4.0000	19.0000	4.0000	0.000	*00.000	*304.53	*0.81	375.33	*0.89
8:00	19.0	6.00	19.0	6.00	19.0000	5.9999	19.0000	5.9999	0.000	*00.000	*290.42	*0.72	375.19	*0.88
9:00	19.0	6.00	19.0	6.00	19.0000	6.0000	19.0000	6.0000	0.000	*00.000	*279.15	*0.67	375.20	*0.91
10:00	19.0	2.00	19.0	2.00	19.0000	2.0000	19.0000	2.0000	0.000	*00.000	*264.64	*0.65	375.24	*0.88
11:00	19.0	0.00	19.0	0.00	19.0000	0.0000	19.0000	0.0000	0.000	*00.000	*258.15	*0.65	375.16	*0.86
12:00	19.0	2.00	19.0	2.00	19.0000	2.0000	19.0000	2.0000	0.000	*00.000	*256.59	*0.64	375.10	*0.89
13:00	19.0	8.00	19.0	8.00	19.0000	8.0000	19.0000	8.0000	0.000	*00.000	*257.33	*0.64	374.90	*0.88
14:00	19.0	8.00	19.0	8.00	19.0000	8.0000	19.0000	8.0000	0.000	*00.000	*248.06	*0.63	-0.17	*0.00
15:00	19.0	8.00	19.0	8.00	19.0000	8.0000	19.0000	8.0000	0.000	*00.000	*244.48	*0.62	166.43	*0.39

PHASE I

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		1	2	3
ORSAT GAS ANALYSIS				
CO2	%	13.30	13.90	13.60
CO	%	0.0	0.0	0.0
O2	%	5.80	5.20	4.95
N2	%	80.90	80.95	81.45
EXCESS AIR	%	37.24	32.16	29.90
DRY GAS MOL WT		30.16	30.45	30.37
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.80	26.40	26.20
STATIC PRESSURE	IN H20	-16.00	-16.40	-16.30
NOZZLE AREA	FT2	.39784E-03	.39784E-03	.39784E-03
PITOT TUBE COEFFICIENT		0.851	0.851	0.851
DGMCF		0.998	0.998	0.998
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	96.	98.	98.
GAS SAMPLE VOL METER COND	FT3	77.63	80.71	83.67
MOISTURE COLLECTED	GRAMS	201.85	177.40	183.05
SAMPLE WEIGHT	GRAMS	12.3279	10.3713	7.5734
AVG STACK TEMP	DEG R	799.8	793.0	805.3
AVG GAS METER TEMP	DEG R	531.3	532.1	542.3
AVG SQ ROOT DELTA P	IN H20	0.82	0.81	0.82
AVG DELTA H	IN H20	2.11	2.23	2.32
AVG LOAD	MW	359.5	359.2	358.2
AVG COAL FLOW RATE	TON/HR	205.5	205.7	204.2
AVG BTU COAL	BTU/LB	8525.	8437.	8517.
AVG HEAT RATE	10**6 BTU/HR	3503.1	3471.8	3479.2
AVG OPACITY	%	3.3	2.8	2.8
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	69.340	70.937	71.631
PERCENT MOISTURE	VOL %	12.09	10.56	10.77
WET STACK GAS MOL WT		28.87	29.13	29.04
ABSOLUTE DUCT PRESS	IN HG	25.62	25.19	25.00
AVG DUCT VELOCITY	FT/SEC	62.00	61.52	62.93
DUCT FLOW DRY STD COND	10**6 DSCFM	0.455	0.455	0.454
DUCT FLOW WET STACK COND	10**6 CFM	0.915	0.908	0.929
PARTICULATE CONC	GRAINS/SCF	2.7433	2.2559	1.6114
PART EMISS RATE	LB/HR	9050.19	7196.19	5075.82
PART EMISS RATE	LB/10**6 BTU	2.5835	2.0727	1.4589
ISOKINETIC VARIATION	%	98.22	98.34	99.58

B-2

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		4	5	6
ORSAT GAS ANALYSIS				
CO2	%	12.45	12.90	13.30
CO	%	0.0	0.0	0.0
O2	%	6.25	6.10	5.30
N2	%	81.30	81.00	81.50
EXCESS AIR	%	41.08	39.91	32.68
DRY GAS MOL WT		30.24	30.31	30.37
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.80	26.40	26.20
STATIC PRESSURE	IN H2O	-15.80	-15.20	-16.00
NOZZLE AREA	FT2	.37950E-03	.37950E-03	.37950E-03
PITOT TUBE COEFFICIENT		0.839	0.839	0.839
DGMCF		1.003	1.003	1.003
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	98.	98.	98.
GAS SAMPLE VOL METER COND	FT3	85.70	90.55	84.05
MOISTURE COLLECTED	GRAMS	183.50	216.10	201.15
SAMPLE WEIGHT	GRAMS	11.6259	10.5237	7.8306
AVG STACK TEMP	DEG R	811.1	805.1	821.4
AVG GAS METER TEMP	DEG R	532.5	535.3	540.9
AVG SQ ROOT DELTA P	IN H2O	0.86	0.85	0.86
AVG DELTA H	IN H2O	1.98	2.08	2.15
AVG LOAD	MW	359.5	359.2	358.2
AVG COAL FLOW RATE	TON/HR	205.5	205.7	204.2
AVG BTU COAL	BTU/LB	8525.	8437.	8517.
AVG HEAT RATE	10**6 BTU/HR	3503.1	3471.8	3479.2
AVG OPACITY	%	3.3	2.8	2.8
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	76.727	79.473	72.466
PERCENT MOISTURE	VOL %	10.15	11.38	11.59
WET STACK GAS MOL WT		29.00	28.91	28.93
ABSOLUTE DUCT PRESS	IN HG	25.64	25.28	25.02
AVG DUCT VELOCITY	FT/SEC	64.73	64.11	66.03
DUCT FLOW DRY STD COND	10**6 DSCFM	0.479	0.465	0.463
DUCT FLOW WET STACK COND	10**6 CFM	0.955	0.946	0.975
PARTICULATE CONC	GRAINS/SCF	2.3380	2.0432	1.6686
PART EMISS RATE	LB/HR	8340.99	7081.91	5502.82
PART EMISS RATE	LB/10**6 BTU	2.3810	2.0398	1.5816
ISOKINETIC VARIATION	%	106.02	113.16	103.51

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		7	8	9
ORSAT GAS ANALYSIS				
CO2	%	13.40	14.41	13.56
CO	%	0.0	0.0	0.0
O2	%	6.20	5.81	5.40
N2	%	80.40	79.77	81.03
EXCESS AIR	%	41.26	38.15	33.76
DRY GAS MOL WT		30.39	30.54	30.39
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.70	26.29	26.06
STATIC PRESSURE	IN H2O	-0.90	-1.00	-0.89
NOZZLE AREA	FT2	.14913E-03	.14914E-03	.14914E-03
PITOT TUBE COEFFICIENT		0.794	0.794	0.794
DGMCF		1.006	1.006	1.006
DUCT CROSS SECT AREA	FT2	339.8	339.8	339.8
TOTAL SAMPLING TIME	MIN	96.	96.	96.
GAS SAMPLE VOL METER COND	FT3	39.34	39.98	39.95
MOISTURE COLLECTED	GRAMS	76.15	78.10	80.50
SAMPLE WEIGHT	GRAMS	0.1267	0.1190	0.0764
AVG STACK TEMP	DEG R	814.9	810.0	820.0
AVG GAS METER TEMP	DEG R	509.8	512.5	515.3
AVG SQ ROOT DELTA P	IN H2O	1.19	1.18	1.20
AVG DELTA H	IN H2O	1.08	1.08	1.09
AVG LOAD	MW	359.5	359.2	358.2
AVG COAL FLOW RATE	TON/HR	205.5	205.7	204.2
AVG BTU COAL	BTU/LB	8525.	8437.	8517.
AVG HEAT RATE	10**6 BTU/HR	3503.1	3471.8	3479.2
AVG OPACITY	%	3.3	2.8	2.8
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	36.671	36.508	35.958
PERCENT MOISTURE	VOL %	8.93	9.18	9.56
WET STACK GAS MOL WT		29.29	29.39	29.20
ABSOLUTE DUCT PRESS	IN HG	26.63	26.22	25.99
AVG DUCT VELOCITY	FT/SEC	82.89	82.34	84.35
DUCT FLOW DRY STD COND	10**6 DSCFM	0.888	0.871	0.870
DUCT FLOW WET STACK COND	10**6 CFM	1.690	1.679	1.720
PARTICULATE CONC	GRAINS/SCF	0.0533	0.0503	0.0328
PART EMISS RATE	LB/HR	370.21	338.01	213.78
PART EMISS RATE	LB/10**6 BTU	0.1057	0.0974	0.0614
ISOKINETIC VARIATION	%	98.09	99.53	98.12

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 1 10/ 8/79 0:30: 0

1 INTG GROSS GENERATION
2 TOTAL INTG COAL FLOW
3 IGNITER GAS FLOW-INTG
4 MAIN GAS FLOW-INTG
5 INLET TEMP EAST 1 HR AVG
6 INLET TEMP WEST 1 HR AVG
7 OUTLET TEMP EAST 1 HR AVG
8 OUTLET TEMP WEST 1 HR AVG
9 TEMP DIFF EAST 1 HR AVG
10 TEMP DIFF WEST 1 HR AVG
11 PRESS DIFF EAST 1 HR AVG
12 PRESS DIFF WEST 1 HR AVG
13 AIR FLOW EAST 1 HR AVG
14 AIR FLOW WEST 1 HR AVG
15
16
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	MWH	TONS	MCF	MCF	DEG F	DEG F	DEG F	DEG F	DEG F	DEG F	IN H20	IN H20	MSCFM	MSCFM
1:00	334.0	168.3	0.0	0.0	356.3	351.8	354.4	346.8	1.9	5.1	7.0	7.4	426.5	408.6
2:00	298.0	152.1	0.0	0.0	351.6	348.6	348.5	342.9	3.2	5.7	6.1	6.5	395.9	373.1
3:00	299.0	151.9	0.0	0.0	355.3	352.8	348.3	343.6	7.0	9.2	6.0	6.4	384.7	365.9
4:00	298.0	152.0	0.0	0.0	356.2	353.7	349.3	345.3	6.9	8.4	6.1	6.5	383.8	366.1
5:00	299.0	152.6	0.0	0.0	358.0	353.6	351.1	345.4	6.9	8.2	6.2	6.7	387.1	368.1
6:00	299.0	152.4	0.0	0.0	362.1	355.6	353.9	347.2	8.3	8.4	6.3	6.8	384.8	368.2
7:00	306.0	156.4	0.0	0.0	360.8	357.6	355.2	348.5	5.7	9.2	6.6	7.1	401.2	379.0
8:00	322.0	165.3	0.0	0.0	362.4	357.5	355.0	349.1	7.4	8.4	6.9	7.6	424.9	396.9
9:00	352.0	179.1	0.0	0.0	357.9	351.8	355.5	346.4	2.4	5.5	7.6	8.3	466.4	447.4
10:00	350.0	179.7	0.0	0.0	348.0	346.7	346.9	340.7	1.1	6.0	7.3	7.5	476.0	431.5
11:00	350.0	180.3	0.0	0.0	351.2	352.2	346.9	343.4	4.3	8.8	7.3	7.6	461.6	429.7
12:00	351.0	180.8	0.0	0.0	360.1	358.9	353.2	348.0	6.9	10.9	7.5	7.8	465.1	427.9
13:00	350.0	179.4	0.0	0.0	361.7	362.0	357.6	353.7	4.1	8.4	7.6	8.0	462.0	427.8
14:00	350.0	180.2	0.0	0.0	362.0	362.4	356.9	354.1	5.1	8.3	7.5	7.9	462.0	428.4
15:00	351.0	180.2	0.0	0.0	367.3	366.8	361.3	357.7	6.1	9.1	7.6	8.1	456.4	427.5
16:00	350.0	180.5	0.0	0.0	373.0	371.3	365.6	362.1	7.3	9.2	7.7	8.2	454.0	423.6
17:00	351.0	179.4	0.0	0.0	376.4	374.4	370.9	366.1	5.5	8.3	7.8	8.3	454.2	422.8
18:00	358.0	183.6	0.0	0.0	362.0	358.8	361.5	356.2	0.5	2.5	7.9	8.2	466.7	436.4
19:00	361.0	185.0	0.0	0.0	364.0	360.4	359.2	354.1	4.8	6.3	7.8	8.1	462.1	435.1
20:00	361.0	185.5	0.0	0.0	367.0	362.2	360.2	355.1	6.8	7.1	8.1	8.5	477.9	440.2
21:00	360.0	185.5	0.0	0.0	370.5	363.6	364.4	356.6	6.1	7.0	8.3	8.7	481.2	450.1
22:00	361.0	182.8	0.0	0.0	364.8	358.2	362.7	354.6	2.1	3.7	8.0	8.3	473.0	442.1
23:00	361.0	183.4	0.0	0.0	352.8	351.2	351.8	347.5	1.0	3.7	7.7	8.0	473.3	435.1
24:00	361.0	184.1	0.0	0.0	355.6	353.8	350.7	347.2	5.0	6.6	7.8	8.0	473.5	433.3

PHASE II

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 2 10/ 9/79 0:31: 9

1 INLET PART LOADING EAST
2 INLET PART LOADING EAST
3 INLET PART LOADING WEST
4 INLET PART LOADING WEST
5 OUTLET PART LOADING EAST
6 OUTLET PART LOADING EAST
7 OUTLET PART LOADING WEST
8 OUTLET PART LOADING WEST
9 PART REMOVAL EFF EAST
10 PART REMOVAL EFF WEST
11 INLET SO2 EAST 1 HR AVG
12 INLET SO2 EAST 1 HR AVG
13 INLET SO2 WEST 1 HR AVG
14 INLET SO2 WEST 1 HR AVG
15
16
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU
1:00	0.6	0.00	0.2	0.00	-0.0073	0.0000	* 0.0000	0.0000	01.298	00.000	262.40	0.48	322.93	0.75
2:00	0.2	0.00	-0.5	0.00	-0.0079	0.0000	* 0.0000	0.0000	04.419	00.000	255.76	0.46	323.51	0.75
3:00	0.2	0.00	-0.5	0.00	-0.0081	0.0000	* 0.0000	0.0000	04.387	00.000	262.83	0.48	322.12	0.76
4:00	0.2	0.00	-0.4	0.00	-0.0082	0.0000	* 0.0000	0.0000	04.216	00.000	260.74	0.47	323.16	0.75
5:00	0.2	0.00	-0.5	0.00	-0.0047	0.0000	* 0.0000	0.0000	02.377	00.000	257.95	0.47	318.05	0.75
6:00	0.3	0.00	0.9	0.00	-0.0105	0.0000	* 0.0000	0.0000	03.867	00.000	257.67	0.47	313.33	0.74
7:00	1.2	0.00	1.1	0.00	-0.0110	0.0000	* 0.0000	0.0000	00.897	00.000	249.09	0.45	318.67	0.74
8:00	2.6	0.00	6.1	0.01	-0.0037	0.0000	* 0.0000	0.0000	00.141	00.000	255.97	0.46	319.40	0.74
9:00	2.7	0.00	5.9	0.01	-0.0027	0.0000	* 0.0000	0.0000	00.099	00.000	253.21	0.46	315.44	0.75
10:00	0.5	0.00	0.6	0.00	-0.0052	0.0000	* 0.0000	0.0000	01.065	00.000	251.35	0.46	305.41	0.73
11:00	0.4	0.00	-0.2	0.00	-0.0068	0.0000	* 0.0000	0.0000	01.764	00.000	250.10	0.45	305.37	0.72
12:00	0.7	0.00	2.7	0.00	-0.0067	0.0000	* 0.0000	0.0000	00.970	00.000	251.37	0.46	320.45	0.75
13:00	2.1	0.00	4.4	0.01	-0.0058	0.0000	* 0.0000	0.0000	00.275	00.000	257.13	0.47	331.98	0.77
14:00	0.6	0.00	1.7	0.00	-0.0027	0.0000	* 0.0000	0.0000	00.431	00.000	256.22	0.47	325.38	0.76
15:00	0.5	0.00	0.1	0.00	-0.0027	0.0000	* 0.0000	0.0000	00.566	00.000	253.03	0.46	329.33	0.75
16:00	0.2	0.00	-0.3	0.00	-0.0027	0.0000	* 0.0000	0.0000	01.449	00.000	251.37	0.46	314.99	0.72
17:00	3.6	0.00	8.9	0.01	-0.0027	0.0000	* 0.0000	0.0000	00.077	00.000	257.31	0.47	321.74	0.74
18:00	1.3	0.00	2.2	0.00	-0.0027	0.0000	* 0.0000	0.0000	00.209	00.000	252.98	0.46	305.75	0.72
19:00	0.7	0.00	1.1	0.00	-0.0027	0.0000	* 0.0000	0.0000	00.380	00.000	255.91	0.47	303.88	0.73
20:00	0.3	0.00	-0.2	0.00	-0.0026	0.0000	* 0.0000	0.0000	00.874	00.000	250.24	0.45	298.03	0.72
21:00	0.3	0.00	2.6	0.00	-0.0026	0.0000	* 0.0000	0.0000	00.345	00.000	242.02	0.44	287.70	0.70
22:00	2.5	0.00	7.5	0.01	-0.0026	0.0000	* 0.0000	0.0000	00.106	00.000	261.80	0.48	292.70	0.70
23:00	0.4	0.00	0.5	0.00	-0.0026	0.0000	* 0.0000	0.0000	00.606	00.000	261.89	0.48	297.23	0.70
24:00	0.2	0.00	0.2	0.00	-0.0026	0.0000	* 0.0000	0.0000	01.184	00.000	257.99	0.47	287.51	0.68

B-6

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 3 10/ 9/79 0:32:16

1 OUTLET SO2 EAST 1 HR AVG
2 OUTLET SO2 EAST 1 HR AVG
3 OUTLET SO2 WEST 1 HR AVG
4 OUTLET SO2 WEST 1 HR AVG
5 SO2 REM EFF EAST 1 HR AVG
6 SO2 REM EFF WEST 1 HR AVG
7 INLET NOX EAST 1 HR AVG
8 INLET NOX EAST 1 HR AVG
9 INLET NOX WEST 1 HR AVG
10 INLET NOX WEST 1 HR AVG
11 OUTLET NOX EAST 1 HR AVG
12 OUTLET NOX EAST 1 HR AVG
13 OUTLET NOX WEST 1 HR AVG
14 OUTLET NOX WEST 1 HR AVG
15 NOX REMOVAL EFF EAST
16 NOX REMOVAL EFF WEST
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%
1:00	159.6	0.39	* 61.7	0.15	18.17	80.54	276.3	0.36	376.9	0.63	177.3	0.31	*157.0	0.27	13.69	57.57
2:00	164.6	0.43	* 67.7	0.16	7.87	78.63	230.5	0.30	312.6	0.52	153.3	0.29	*129.7	0.22	4.84	57.62
3:00	178.2	0.44	* 52.5	0.13	7.51	83.35	227.0	0.30	298.3	0.50	154.0	0.27	*108.9	0.19	7.41	62.71
4:00	185.3	0.46	* 49.7	0.12	2.51	84.30	224.3	0.29	296.6	0.50	150.9	0.27	* 99.6	0.17	7.73	65.69
5:00	183.7	0.46	*130.5	0.31	1.82	58.14	226.1	0.29	303.4	0.51	152.0	0.27	*173.4	0.30	7.36	41.69
6:00	194.1	0.48	*152.8	0.37	-2.93	50.32	228.2	0.30	308.8	0.52	158.5	0.28	*194.6	0.33	5.13	35.80
7:00	186.4	0.47	*176.4	0.42	-3.97	43.42	232.0	0.30	313.5	0.52	159.0	0.29	*214.6	0.37	4.79	30.01
8:00	195.7	0.48	*155.6	0.37	-4.06	50.04	242.5	0.32	330.9	0.55	166.3	0.30	*209.3	0.36	6.64	35.33
9:00	187.1	0.46	*148.7	0.36	0.09	52.10	297.3	0.39	421.6	0.72	200.2	0.35	*267.3	0.46	8.91	35.59
10:00	183.4	0.45	*137.9	0.33	1.32	54.09	293.5	0.38	422.0	0.72	198.3	0.35	*257.5	0.45	8.61	37.97
11:00	185.7	0.45	*136.1	0.32	-0.12	54.69	280.9	0.37	408.8	0.69	190.7	0.34	*247.4	0.42	8.48	38.25
12:00	175.3	0.43	*124.9	0.30	5.92	60.16	248.3	0.32	353.4	0.59	161.0	0.28	*203.9	0.35	12.54	41.02
13:00	163.9	0.41	*110.7	0.26	11.91	65.85	246.6	0.32	349.8	0.58	155.7	0.28	*181.8	0.31	12.73	46.79
14:00	144.6	0.36	* 58.4	0.14	23.37	81.92	264.7	0.35	372.0	0.62	162.1	0.29	*145.8	0.25	16.86	60.49
15:00	132.0	0.33	* 11.2	0.03	28.82	96.49	248.0	0.32	355.9	0.59	144.7	0.26	* 84.9	0.14	20.39	75.47
16:00	126.8	0.31	* 82.4	0.19	32.28	73.22	239.9	0.31	326.4	0.54	135.9	0.24	*156.5	0.26	23.76	50.93
17:00	124.9	0.31	*110.0	0.26	34.30	64.98	240.7	0.31	336.3	0.55	134.1	0.24	*187.3	0.32	24.58	42.94
18:00	121.6	0.30	* 98.8	0.24	35.00	67.08	291.2	0.38	385.8	0.65	164.5	0.29	*222.7	0.38	23.56	41.21
19:00	124.4	0.30	*103.2	0.25	36.17	65.94	302.6	0.39	396.9	0.67	173.3	0.30	*232.6	0.40	24.49	40.24
20:00	122.7	0.29	*100.2	0.25	35.56	65.76	306.5	0.40	396.4	0.68	174.0	0.30	*236.1	0.42	25.37	39.33
21:00	118.7	0.28	*122.5	0.30	35.35	56.46	311.0	0.41	402.4	0.70	177.2	0.30	*264.5	0.47	24.92	32.77
22:00	133.6	0.32	*154.7	0.38	32.93	45.97	304.2	0.40	400.9	0.69	180.3	0.31	*283.2	0.50	22.08	27.78
23:00	142.5	0.34	*167.3	0.40	28.38	42.69	342.1	0.45	446.9	0.76	212.4	0.36	*328.8	0.57	18.29	25.09
24:00	142.9	0.34	*166.4	0.40	27.18	40.96	350.0	0.46	478.9	0.81	218.7	0.38	*339.1	0.59	17.85	27.76

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 5 10/ 9/79 0:34:26

1 OUTLET DAMPER COMP# 1 EAST
2 OUTLET DAMPER COMP# 2 EAST
3 OUTLET DAMPER COMP# 3 EAST
4 OUTLET DAMPER COMP# 4 EAST
5 OUTLET DAMPER COMP# 5 EAST
6 OUTLET DAMPER COMP# 6 EAST
7 OUTLET DAMPER COMP# 7 EAST
8 OUTLET DAMPER COMP# 8 EAST
9 OUTLET DAMPER COMP# 9 EAST
10 OUTLET DAMPER COMP#10 EAST
11 OUTLET DAMPER COMP#11 EAST
12 OUTLET DAMPER COMP#12 EAST
13 OUTLET DAMPER COMP#13 EAST
14 OUTLET DAMPER COMP#14 EAST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	COMP 1	COMP 2	COMP 3	COMP 4	COMP 5	COMP 6	COMP 7	COMP 8	COMP 9	COMP 10	COMP 11	COMP 12	COMP 13	COMP 14
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
19:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
20:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
21:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
22:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
23:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
24:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 4 10/ 9/79 0:33:21

1 INLET O2 EAST 1 HR AVG
2 INLET O2 WEST 1 HR AVG
3 OUTLET O2 EAST 1 HR AVG
4 OUTLET O2 WEST 1 HR AVG
5 PERCENT INCR O2 EAST 1HR AVG
6 PERCENT INCR O2 WEST 1HR AVG
7 STACK OPACITY 1HR AVG
8 STACK SO2 1HR AVG
9 STACK NOX 1HR AVG
10 STACK O2 1HR AVG
11 BYPASS DAMPER STATUS EAST
12 BYPASS DAMPER STATUS WEST
13 AMBIENT TEMP INST
14 BARO PRESS UNCORR INST
15 CALC ENERGY CONSUMPTION
16 AIR/CLOTH RATIO EAST 1HR AVG
17 AIR/CLOTH RATIO WEST 1HR AVG
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	%	%	%	%	%	%	%	LB/ MMBTU	LB/ MMBTU	%	OPEN/ SHUT	OPEN/ SHUT	DEG F	IN HG	KWH	FT/ MIN	FT/ MIN
1:00	* 0.0	4.5	5.2	4.8	919.0	6.4	8.7	0.71	0.67	5.5	SHUT	SHUT	70.1	26.21	2103.4	3.36	3.19
2:00	* 0.0	4.5	6.1	4.8	919.0	7.6	8.6	0.71	0.55	6.1	SHUT	SHUT	68.9	26.20	1673.1	3.07	2.88
3:00	* 0.0	4.6	5.4	4.9	919.0	7.2	8.6	0.71	0.51	5.8	SHUT	SHUT	69.4	26.21	1603.4	2.98	2.82
4:00	* 0.0	4.5	5.5	4.8	919.0	7.5	8.6	0.70	0.51	5.8	SHUT	SHUT	62.4	26.20	1624.1	2.98	2.83
5:00	* 0.0	4.6	5.8	4.9	919.0	6.8	8.6	0.70	0.52	5.9	SHUT	SHUT	62.0	26.21	1682.1	3.01	2.85
6:00	* 0.0	4.6	5.5	4.9	919.0	6.3	8.4	0.70	0.52	5.9	SHUT	SHUT	61.0	26.21	1703.1	3.01	2.86
7:00	* 0.0	4.4	5.7	4.7	919.0	7.8	8.3	0.69	0.54	5.9	SHUT	SHUT	63.3	26.21	1851.1	3.15	2.95
8:00	* 0.0	4.5	5.4	4.8	919.0	7.7	8.6	0.71	0.57	5.8	SHUT	SHUT	61.8	26.21	2091.9	3.35	3.11
9:00	* 0.0	4.8	5.3	5.0	919.0	5.1	8.7	0.73	0.75	* 5.7	SHUT	SHUT	61.9	26.21	2568.7	3.72	3.53
10:00	* 0.0	4.8	5.3	5.0	919.0	5.3	8.7	0.51	0.54	0.0	SHUT	SHUT	66.9	26.21	2350.3	3.75	3.37
11:00	* 0.0	4.6	5.3	4.9	919.0	6.8	8.7	0.50	0.52	0.0	SHUT	SHUT	74.3	26.21	2316.8	3.63	3.37
12:00	* 0.0	4.5	5.3	4.8	919.0	7.7	8.6	0.50	0.45	0.0	SHUT	SHUT	87.4	26.21	2401.0	3.69	3.38
13:00	* 0.0	4.4	5.6	4.7	919.0	8.4	8.7	0.52	0.45	0.0	SHUT	SHUT	91.3	26.21	2449.5	3.69	3.40
14:00	* 0.0	4.5	5.4	4.6	919.0	3.0	8.9	0.51	0.49	0.0	SHUT	SHUT	93.5	26.22	2428.2	3.68	3.41
15:00	* 0.0	* 4.2	5.4	4.7	919.0	10.6	8.7	0.51	0.45	0.0	SHUT	SHUT	96.0	26.21	2466.7	3.66	3.42
16:00	* 0.0	* 4.3	5.2	4.6	919.0	8.7	8.6	0.51	0.43	0.0	SHUT	SHUT	96.8	26.21	2485.3	3.66	3.41
17:00	* 0.0	* 4.2	5.3	4.6	919.0	9.2	8.7	0.52	0.43	0.0	SHUT	SHUT	96.7	26.21	2548.7	3.69	3.42
18:00	* 0.0	* 4.6	5.3	4.9	919.0	6.3	8.7	0.51	0.54	0.0	SHUT	SHUT	94.1	26.21	2593.3	3.75	3.49
19:00	* 0.0	* 4.6	4.9	4.9	919.0	6.6	8.8	0.51	0.55	0.0	SHUT	SHUT	87.8	26.21	2547.7	3.70	3.47
20:00	* 0.0	* 5.0	4.9	5.3	919.0	5.6	8.8	0.50	0.56	0.0	SHUT	SHUT	78.9	26.21	2706.8	3.85	3.52
21:00	* 0.0	* 5.2	4.9	5.5	919.0	6.5	8.6	0.54	0.57	0.0	SHUT	SHUT	74.2	26.21	2839.8	3.90	3.62
22:00	* 0.0	* 4.9	4.9	5.2	919.0	6.9	8.7	0.52	0.55	0.0	SHUT	SHUT	71.4	26.21	2656.2	3.81	3.53
23:00	* 0.0	* 4.7	4.9	5.0	919.0	6.0	8.6	0.52	0.62	0.0	SHUT	SHUT	69.4	26.20	2499.1	3.75	3.44
24:00	* 0.0	* 4.7	4.9	5.0	919.0	6.6	8.8	0.50	0.64	0.0	SHUT	SHUT	69.5	26.22	2528.6	3.76	3.42

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 6 10/ 9/79 0:35:29

1 OUTLET DAMPER COMP#15 WEST
2 OUTLET DAMPER COMP#16 WEST
3 OUTLET DAMPER COMP#17 WEST
4 OUTLET DAMPER COMP#18 WEST
5 OUTLET DAMPER COMP#19 WEST
6 OUTLET DAMPER COMP#20 WEST
7 OUTLET DAMPER COMP#21 WEST
8 OUTLET DAMPER COMP#22 WEST
9 OUTLET DAMPER COMP#23 WEST
10 OUTLET DAMPER COMP#24 WEST
11 OUTLET DAMPER COMP#25 WEST
12 OUTLET DAMPER COMP#26 WEST
13 OUTLET DAMPER COMP#27 WEST
14 OUTLET DAMPER COMP#28 WEST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	COMP 15	COMP 16	COMP 17	COMP 18	COMP 19	COMP 20	COMP 21	COMP 22	COMP 23	COMP 24	COMP 25	COMP 26	COMP 27	COMP 28
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
19:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
20:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
21:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
22:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
23:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
24:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER EAST INLET		1	2	3
ORSAT GAS ANALYSIS				
CO2	%	12.30	12.80	13.40
CO	%	0.0	0.0	0.0
O2	%	7.10	6.30	6.06
N2	%	80.60	80.90	80.53
EXCESS AIR	%	50.08	41.84	39.91
DRY GAS MOL WT		30.25	30.30	30.39
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.38	26.30	26.17
STATIC PRESSURE	IN H20	-17.50	-17.50	-16.20
NOZZLE AREA	FT2	.36829E-03	.37953E-03	.38522E-03
PITOT TUBE COEFFICIENT		0.850	0.850	0.850
DGMCF		0.975	0.975	0.975
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	147.	126.	140.
GAS SAMPLE VOL METER COND	FT3	123.40	110.82	128.57
MOISTURE COLLECTED	GRAMS	231.00	153.00	275.50
SAMPLE WEIGHT	GRAMS	9.0300	9.3051	11.1882
AVG STACK TEMP	DEG R	791.5	796.9	781.2
AVG GAS METER TEMP	DEG R	565.3	564.8	544.2
AVG SQ FOOT DELTA P	IN H20	0.82	0.84	0.83
AVG DELTA H	IN H20	1.96	2.15	2.14
AVG LOAD	MW	350.5	350.5	350.5
AVG COAL FLOW RATE	TON/HR	177.2	176.4	176.8
AVG BTU COAL	BTU/LB	8936.	8955.	8853.
AVG HEAT RATE	10**6 BTU/HR	3166.6	3174.3	3131.3
AVG OPACITY	%	8.8	8.7	8.6
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	99.573	88.975	106.987
PERCENT MOISTURE	VOL %	9.87	7.51	10.84
WET STACK GAS MOL WT		29.04	29.38	29.04
ABSOLUTE DUCT PRESS	IN HG	25.09	25.01	24.98
AVG DUCT VELOCITY	FT/SEC	62.38	63.26	62.89
DUCT FLOW DRY STD COND	10**6 DSCFM	0.464	0.478	0.467
DUCT FLOW WET STACK COND	10**6 CFM	0.921	0.934	0.928
PARTICULATE CONC	GRAINS/SCF	1.3993	1.6137	1.6136
PART EMISS RATE	LB/HR	4571.23	5186.94	4770.43
PART EMISS RATE	LB/10**6 BTU	1.4436	1.6340	1.5235
ISOKINETIC VARIATION	%	97.49	99.73	98.88

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER WEST INLET		4	5	6
ORSAT GAS ANALYSIS				
CO2	%	13.20	13.43	13.35
CO	%	0.0	0.0	0.0
O2	%	5.90	5.93	6.00
N2	%	80.90	79.63	80.65
EXCESS AIR	%	38.17	39.33	39.24
DRY GAS MOL WT		30.35	30.55	30.38
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.38	26.30	26.17
STATIC PRESSURE	IN H2O	-16.30	-17.70	-17.70
NOZZLE AREA	FT2	.35721E-03	.37611E-03	.38522E-03
PITOT TUBE COEFFICIENT		0.860	0.860	0.860
DGMCF		0.974	0.974	0.974
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	150.	117.	147.
GAS SAMPLE VOL METER COND	FT3	122.83	123.87	130.87
MOISTURE COLLECTED	GRAMS	217.50	213.10	180.50
SAMPLE WEIGHT	GRAMS	8.5369	9.4664	5.1964
AVG STACK TEMP	DEG R	787.9	805.3	780.5
AVG GAS METER TEMP	DEG R	573.7	571.3	544.0
AVG SQ ROOT DELTA P	IN H2O	0.83	0.80	0.81
AVG DELTA H	IN H2O	2.00	2.23	2.38
AVG LOAD	MW	350.5	351.5	350.5
AVG COAL FLOW RATE	TON/HR	177.2	176.4	176.9
AVG BTU COAL	BTU/LB	8936.	8995.	8853.
AVG HEAT RATE	10**6 BTU/HR	3166.6	3174.3	3131.3
AVG CPACITY	%	8.8	8.7	8.6
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	97.588	103.394	108.897
PERCENT MOISTURE	VOL %	9.52	8.87	7.26
WET STACK GAS MOL WT		29.17	29.43	29.48
ABSOLUTE DUCT PRESS	IN HG	25.18	25.00	24.87
AVG DUCT VELOCITY	FT/SEC	62.83	61.69	61.43
DUCT FLOW DRY STD COND	10**6 DSCFM	0.473	0.455	0.473
DUCT FLOW WET STACK COND	10**6 CFM	0.927	0.911	0.907
PARTICULATE CONC	GRAINS/SCF	1.4130	1.4127	0.7363
PART EMISS RATE	LB/HR	4527.62	4188.84	2347.92
PART EMISS RATE	LB/10**6 BTU	1.4298	1.3196	0.7498
ISOKINETIC VARIATION	%	94.71	101.24	100.11

PAGE NO. 2

B-12

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER STACK		7	8	9
ORSAT GAS ANALYSIS				
CO2	%	12.72	14.53	13.20
CO	%	0.0	0.0	0.0
O2	%	6.30	5.03	6.26
N2	%	80.97	79.43	80.54
EXCESS AIR	%	41.78	40.41	41.78
DRY GAS MOL WT		30.29	30.57	30.36
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.24	26.15	26.03
STATIC PRESSURE	IN H20	-0.89	-0.88	-0.80
NOZZLE AREA	FT2	.14443E-03	.14421E-03	.14737E-03
PITOT TUBE COEFFICIENT		0.870	0.870	0.870
DCMCF		0.973	0.973	0.973
DUCT CROSS SECT AREA	FT2	339.8	339.8	339.8
TOTAL SAMPLING TIME	MIN	120.	120.	120.
GAS SAMPLE VOL METER COND	FT3	50.36	54.03	54.75
MOISTURE COLLECTED	GRAMS	104.30	106.70	113.00
SAMPLE WEIGHT	GRAMS	0.0268	0.0308	0.0324
AVG STACK TEMP	DEG R	799.9	806.8	784.8
AVG GAS METER TEMP	DEG R	538.5	547.0	537.2
AVG SQ ROOT DELTA P	IN H20	1.12	1.11	1.12
AVG DELTA H	IN H20	1.24	1.27	1.28
AVG LOAD	MW	350.5	350.5	350.5
AVG COAL FLOW RATE	TON/HR	177.2	176.4	176.8
AVG BTU COAL	BTU/LB	8936.	8955.	8853.
AVG HEAT RATE	10**6 BTU/HR	3166.6	3179.3	3131.3
AVG OPACITY	%	8.8	8.7	8.6
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	42.271	44.508	45.694
PERCENT MOISTURE	VOL %	10.44	10.17	10.46
WET STACK GAS MOL WT		29.01	29.29	29.07
ABSOLUTE DUCT PRESS	IN HG	26.17	26.10	25.97
AVG DUCT VELOCITY	FT/SEC	85.55	84.52	84.97
DUCT FLOW DRY STD COND	10**6 DSCFM	0.902	0.894	0.905
DUCT FLOW WET STACK COND	10**6 CFM	1.744	1.723	1.730
PARTICULATE CONC	GRAINS/SCF	0.0098	0.0107	0.0109
PART EMISS RATE	LB/HR	62.44	65.56	68.29
PART EMISS RATE	LB/10**6 BTU	0.0197	0.0207	0.0218
ISOKINETIC VARIATION	%	91.90	98.93	97.07

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER WEST OUTLET		10	11	12
ORSAT GAS ANALYSIS				
CO2	%	12.73	12.76	12.63
CO	%	0.0	0.0	0.0
O2	%	6.13	6.50	6.36
N2	%	81.13	80.74	81.00
EXCESS AIR	%	40.14	43.89	42.38
DRY GAS MOL WT		30.28	30.30	30.28
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.38	26.30	26.17
STATIC PRESSURE	IN H2O	-24.50	-25.80	-24.50
NOZZLE AREA	FT2	.319785-03	.406040-03	.37165E-03
PITOT TUBE COEFFICIENT		0.860	0.860	0.860
DGMCF		1.030	1.030	1.030
DUCT CROSS SECT AREA	FT2	369.0	369.0	369.0
TOTAL SAMPLING TIME	MIN	144.	148.	148.
GAS SAMPLE VOL METER COND	FT3	67.71	82.79	88.61
MOISTURE COLLECTED	GRAMS	143.00	177.00	171.10
SAMPLE WEIGHT	GRAMS	0.0438	0.1111	0.1397
AVG STACK TEMP	DEG R	782.3	786.2	765.5
AVG GAS METER TEMP	DEG R	558.6	562.1	541.2
AVG SQ ROOT DELTA P	IN H2O	0.52	0.49	0.52
AVG DELTA H	IN H2O	0.62	0.80	0.87
AVG LOAD	MW	350.5	353.5	350.5
AVG COAL FLOW RATE	TON/HR	177.2	176.4	176.8
AVG BTU COAL	BTU/LB	8936.	8595.	8863.
AVG HEAT RATE	10**6 BTU/HR	3166.6	3174.3	3131.3
AVG OPACITY	%	8.8	8.7	8.6
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	58.190	70.537	78.038
PERCENT MOISTURE	VOL %	10.40	11.63	9.38
WET STACK GAS MOL WT		29.00	29.00	29.12
ABSOLUTE DUCT PRESS	IN HG	24.58	24.49	24.37
AVG DUCT VELOCITY	FT/SEC	40.34	38.28	39.77
DUCT FLOW DRY STD COND	10**6 DSCFM	0.444	0.415	0.448
DUCT FLOW WET STACK COND	10**6 CFM	0.893	0.843	0.880
PARTICULATE CONC	GRAINS/SCF	0.0116	0.0241	0.0276
PART EMISS RATE	LB/HR	36.76	76.54	89.42
PART EMISS RATE	LB/10**6 BTU	0.0114	0.0241	0.0286
ISOKINETIC VARIATION	%	105.13	104.38	116.85

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER EAST OUTLET		13	14	15
ORSAT GAS ANALYSIS				
CO2	%	12.60	13.33	12.86
CO	%	0.0	0.0	0.0
O2	%	6.31	3.93	6.22
N2	%	81.09	80.73	80.73
EXCESS AIR	%	41.84	38.59	41.21
DRY GAS MOL WT		30.27	30.37	30.26
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.38	26.30	26.17
STATIC PRESSURE	IN H20	-24.50	-23.10	-24.50
NOZZLE AREA	FT2	.37727E-03	.37614E-03	.39522E-03
PITOT TUBE COEFFICIENT		0.840	0.840	0.840
DGMCF		1.030	1.030	1.030
DUCT CROSS SECT AREA	FT2	369.0	369.0	369.0
TOTAL SAMPLING TIME	MIN	147.	147.	147.
GAS SAMPLE VOL METER COND	FT3	70.09	68.06	72.76
MOISTURE COLLECTED	GRAMS	149.00	145.50	157.50
SAMPLE WEIGHT	GRAMS	0.0574	0.0527	0.1097
AVG STACK TEMP	DEG R	768.5	793.7	766.7
AVG GAS METER TEMP	DEG R	542.2	536.5	548.8
AVG SQ ROOT DELTA P	IN H20	0.53	0.49	0.51
AVG DELTA H	IN H20	0.66	0.66	0.69
AVG LOAD	MW	350.5	350.3	350.5
AVG COAL FLOW RATE	TON/HR	177.2	178.4	176.8
AVG BTU COAL	BTU/LB	8936.	8597.	8853.
AVG HEAT RATE	10**6 BTU/HR	3166.6	3174.3	3131.3
AVG OPACITY	%	8.8	8.7	8.6
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	62.078	58.540	63.170
PERCENT MOISTURE	VOL %	10.18	10.51	10.54
WET STACK GAS MOL WT		29.02	29.07	28.96
ABSOLUTE DUCT PRESS	IN HG	24.58	24.60	24.37
AVG DUCT VELOCITY	FT/SEC	39.54	37.47	38.18
DUCT FLOW DRY STD COND	10**6 DSCFM	0.444	0.405	0.424
DUCT FLOW WET STACK COND	10**6 CFM	0.875	0.829	0.845
PARTICULATE CONC	GRAINS/SCF	0.0143	0.0139	0.0268
PART EMISS RATE	LB/HR	46.02	42.64	85.89
PART EMISS RATE	LB/10**6 BTU	0.0145	0.0134	0.0274
ISOKINETIC VARIATION	%	93.12	96.49	97.06

B-15

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 2 3/24/80 19:23:25

1 INLET PART LOADING EAST
2 INLET PART LOADING EAST
3 INLET PART LOADING WEST
4 INLET PART LOADING WEST
5 OUTLET PART LOADING EAST
6 OUTLET PART LOADING EAST
7 OUTLET PART LOADING WEST
8 OUTLET PART LOADING WEST
9 PART REMOVAL EFF EAST
10 PART REMOVAL EFF WEST
11 INLET SO2 EAST 1 HR AVG
12 INLET SO2 EAST 1 HR AVG
13 INLET SO2 WEST 1 HR AVG
14 INLET SO2 WEST 1 HR AVG
15
16
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU
1:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	219.19	0.55	194.61	0.45
2:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	223.69	0.55	191.93	0.44
3:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	236.80	0.56	191.19	0.46
4:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	237.37	0.62	203.19	0.50
5:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	231.81	0.62	212.32	0.54
6:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	231.01	0.63	217.46	0.56
7:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	255.41	0.66	236.77	0.58
8:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	255.30	0.61	217.41	0.52
9:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	214.50	0.53	183.44	0.43
10:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	226.11	0.52	176.09	0.42
11:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	219.98	0.50	175.83	0.42
12:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	206.79	0.51	190.70	0.45
13:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	208.31	0.50	185.16	0.44
14:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	209.42	0.50	183.21	0.43
15:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	210.37	0.51	191.00	0.45
16:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	200.53	0.49	190.17	0.44
17:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	203.06	0.49	183.89	0.43
18:00	0.0	0.00	0.0	0.00	0.0000	0.0000	0.0000	0.0000	19.000	19.000	207.94	0.48	175.85	0.42

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 3 3/24/80 19:24:30

1 OUTLET SO2 EAST 1 HR AVG
2 OUTLET SO2 EAST 1 HR AVG
3 OUTLET SO2 WEST 1 HR AVG
4 OUTLET SO2 WEST 1 HR AVG
5 SO2 REM EFF EAST 1 HR AVG
6 SO2 REM EFF WEST 1 HR AVG
7 INLET NOX EAST 1 HR AVG
8 INLET NOX EAST 1 HR AVG
9 INLET NOX WEST 1 HR AVG
10 INLET NOX WEST 1 HR AVG
11 OUTLET NOX EAST 1 HR AVG
12 OUTLET NOX EAST 1 HR AVG
13 OUTLET NOX WEST 1 HR AVG
14 OUTLET NOX WEST 1 HR AVG
15 NOX REMOVAL EFF EAST
16 NOX REMOVAL EFF WEST
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%
1:00	212.4	0.52	*-58.1	0.14	4.64	130.16	244.6	0.44	278.8	0.46	245.4	0.43	* 2.8	0.00	1.31	99.00
2:00	207.9	0.50	*-53.0	0.12	8.35	128.02	265.8	0.47	312.0	0.52	259.0	0.45	* 12.2	0.02	3.91	96.05
3:00	222.2	0.52	*-50.6	0.12	7.75	126.92	290.3	0.49	336.1	0.58	284.0	0.47	* 16.8	0.03	3.80	94.93
4:00	243.9	0.63	*-53.6	0.13	-1.23	126.78	191.0	0.36	203.2	0.36	211.6	0.39	* 10.3	0.02	-9.13	94.88
5:00	258.8	0.68	*-52.8	0.14	-9.76	125.15	133.8	0.26	121.3	0.22	167.7	0.32	*-4.0	-0.01	-23.23	96.66
6:00	253.3	0.68	*-40.1	0.10	-7.70	118.64	142.5	0.28	136.6	0.25	174.9	0.34	* 9.8	0.02	-20.60	92.72
7:00	267.8	0.68	* 1.2	0.00	-2.94	99.47	169.6	0.32	162.0	0.29	199.7	0.36	* 45.3	0.08	-15.62	71.68
8:00	242.3	0.57	* 13.5	0.03	7.09	93.67	229.7	0.40	253.8	0.44	241.4	0.41	* 74.9	0.13	-2.84	69.85
9:00	187.7	0.46	* -8.2	0.02	14.67	104.51	272.3	0.49	330.0	0.56	254.4	0.44	* -9.5	0.02	8.88	102.91
10:00	188.9	0.43	* -9.3	0.02	18.42	105.38	259.4	0.43	297.3	0.51	233.8	0.38	*-20.5	0.04	11.99	107.03
11:00	183.9	0.41	* -9.2	0.02	18.51	105.33	256.7	0.42	292.7	0.51	228.6	0.37	*-20.5	-0.04	13.21	107.15
12:00	165.6	0.40	55.9	0.13	22.01	70.24	274.4	0.49	341.4	0.58	238.6	0.41	91.1	0.16	15.31	72.91
13:00	165.9	0.39	165.2	0.40	22.15	9.25	279.4	0.48	340.1	0.58	243.1	0.41	274.6	0.48	14.97	17.87
14:00	161.7	0.37	175.4	0.42	24.49	2.52	290.8	0.49	352.4	0.59	250.4	0.42	289.3	0.50	15.80	16.42
15:00	148.7	0.35	188.7	0.45	31.02	-0.41	287.1	0.50	352.1	0.59	241.0	0.41	316.4	0.54	18.07	8.67
16:00	133.8	0.32	191.5	0.45	34.93	-2.01	298.0	0.52	386.9	0.65	249.5	0.43	352.1	0.60	18.35	7.80
17:00	131.1	0.31	186.6	0.44	36.80	-2.79	297.2	0.51	388.1	0.65	248.6	0.42	349.2	0.59	18.14	8.84
18:00	136.8	0.31	176.4	0.43	35.90	-2.30	285.2	0.48	346.3	0.59	239.8	0.39	310.6	0.54	18.07	8.51

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 4 3/24/80 19:25:35

1 INLET O2 EAST 1 HR AVG
2 INLET O2 WEST 1 HR AVG
3 OUTLET O2 EAST 1 HR AVG
4 OUTLET O2 WEST 1 HR AVG
5 PERCENT INCR O2 EAST 1HR AVG
6 PERCENT INCR O2 WEST 1HR AVG
7 STACK OPACITY 1HR AVG
8 STACK SO2 1HR AVG
9 STACK NOX 1HR AVG
10 STACK O2 1HR AVG
11 BYPASS DAMPER STATUS EAST
12 BYPASS DAMPER STATUS WEST
13 AMBIENT TEMP INST
14 BARO PRESS UNCORR INST
15 CALC ENERGY CONSUMPTION
16 AIR/CLOTH RATIO EAST 1HR AVG
17 AIR/CLOTH RATIO WEST 1HR AVG
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	%	%	%	%	%	%	%	LB/ MMBTU	LB/ MMBTU	%	OPEN/ SHUT	OPEN/ SHUT	DEG F	IN HG	KWH	FT/ MIN	FT/ MIN
1:00	5.5	4.3	5.3	4.5	-4.4	3.6	2.0	0.59	0.52	4.9	SHUT	SHUT	31.0	26.16	1711.6	2.71	2.93
2:00	5.3	4.4	5.1	4.6	-4.0	5.0	2.1	0.59	0.58	4.9	SHUT	SHUT	29.1	26.16	2019.6	2.90	3.15
3:00	4.7	5.0	4.4	5.3	-5.7	5.2	2.2	0.60	0.63	4.9	SHUT	SHUT	29.0	26.21	1920.3	2.81	3.12
4:00	6.2	5.3	6.0	5.5	-3.4	4.2	1.9	0.61	0.39	5.8	SHUT	SHUT	28.4	26.20	924.8	1.97	2.20
5:00	6.5	5.7	6.2	5.9	-3.6	2.8	1.7	0.62	0.26	6.1	SHUT	SHUT	30.5	26.21	412.1	1.50	1.67
6:00	6.8	5.9	6.6	6.0	-3.6	2.7	1.6	0.66	0.29	6.3	SHUT	SHUT	28.4	26.23	434.3	1.56	1.75
7:00	6.1	5.3	5.8	5.5	-4.4	3.7	1.9	0.75	0.35	5.7	SHUT	SHUT	27.8	26.29	741.7	1.99	2.20
8:00	5.0	5.0	4.6	5.3	-6.7	6.2	2.0	0.71	0.50	5.0	SHUT	SHUT	29.8	26.28	1286.2	2.46	2.67
9:00	5.5	4.6	5.1	4.8	-6.8	4.7	2.1	0.63	0.65	5.0	SHUT	SHUT	35.3	26.28	2185.9	3.01	3.33
10:00	4.3	4.8	3.9	5.1	-8.9	6.3	2.0	0.60	0.57	4.6	SHUT	SHUT	40.6	26.29	2239.0	2.97	3.30
11:00	4.2	5.0	3.7	5.3	-10.1	6.3	2.1	0.56	0.56	4.6	SHUT	SHUT	43.4	26.28	2392.3	3.07	3.34
12:00	5.4	4.8	5.0	5.0	-7.4	4.9	2.3	0.57	0.65	5.0	SHUT	SHUT	44.8	26.29	2555.7	3.18	3.44
13:00	4.9	4.8	4.6	5.0	-7.2	5.4	2.3	0.56	0.65	4.8	SHUT	SHUT	46.9	26.29	2458.7	3.19	3.40
14:00	4.7	4.6	4.4	4.9	-7.5	6.1	2.3	0.56	0.66	4.6	SHUT	SHUT	48.3	26.28	2357.2	3.05	3.37
15:00	5.0	4.5	4.6	4.8	-7.5	5.7	2.4	0.58	0.66	4.7	SHUT	SHUT	48.9	26.28	2424.8	3.14	3.37
16:00	5.3	4.5	4.9	4.7	-7.2	4.6	2.9	0.55	0.70	4.8	SHUT	SHUT	49.0	26.28	2437.8	3.15	3.39
17:00	5.0	4.5	4.6	4.7	-6.7	4.6	2.7	0.54	0.69	4.7	SHUT	SHUT	48.0	26.28	2495.6	3.16	3.42
18:00	4.4	4.7	4.0	5.0	-9.3	6.5	2.8	0.53	0.62	4.5	SHUT	SHUT	46.9	26.26	2532.6	3.14	3.42

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 5

3/24/80 19:26:39

1 OUTLET DAMPER COMP# 1 EAST
2 OUTLET DAMPER COMP# 2 EAST
3 OUTLET DAMPER COMP# 3 EAST
4 OUTLET DAMPER COMP# 4 EAST
5 OUTLET DAMPER COMP# 5 EAST
6 OUTLET DAMPER COMP# 6 EAST
7 OUTLET DAMPER COMP# 7 EAST
8 OUTLET DAMPER COMP# 8 EAST
9 OUTLET DAMPER COMP# 9 EAST
10 OUTLET DAMPER COMP#10 EAST
11 OUTLET DAMPER COMP#11 EAST
12 OUTLET DAMPER COMP#12 EAST
13 OUTLET DAMPER COMP#13 EAST
14 OUTLET DAMPER COMP#14 EAST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	COMP 1	COMP 2	COMP 3	COMP 4	COMP 5	COMP 6	COMP 7	COMP 8	COMP 9	COMP 10	COMP 11	COMP 12	COMP 13	COMP 14
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 6 3/24/80 19:27:43

1 OUTLET DAMPER COMP#15 WEST
2 OUTLET DAMPER COMP#16 WEST
3 OUTLET DAMPER COMP#17 WEST
4 OUTLET DAMPER COMP#18 WEST
5 OUTLET DAMPER COMP#19 WEST
6 OUTLET DAMPER COMP#20 WEST
7 OUTLET DAMPER COMP#21 WEST
8 OUTLET DAMPER COMP#22 WEST
9 OUTLET DAMPER COMP#23 WEST
10 OUTLET DAMPER COMP#24 WEST
11 OUTLET DAMPER COMP#25 WEST
12 OUTLET DAMPER COMP#26 WEST
13 OUTLET DAMPER COMP#27 WEST
14 OUTLET DAMPER COMP#28 WEST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	COMP 15	COMP 16	COMP 17	COMP 18	COMP 19	COMP 20	COMP 21	COMP 22	COMP 23	COMP 24	COMP 25	COMP 26	COMP 27	COMP 28
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		EO1 1	EU2 2	EU3 3
ORSAT GAS ANALYSIS				
CO2	%	14.00	14.00	13.93
CO	%	0.0	0.0	0.0
O2	%	5.03	5.03	4.86
N2	%	80.96	80.96	81.20
EXCESS AIR	%	30.81	30.81	29.36
DRY GAS MOL WT		30.44	30.44	30.42
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.07	26.18	26.12
STATIC PRESSURE	IN H20	-28.60	-28.60	-28.60
NOZZLE AREA	FT2	.80014E-03	.37158E-03	.37158E-03
PITOT TUBE COEFFICIENT		0.840	0.840	0.840
DGMCF		0.980	0.980	0.980
DUCT CROSS SECT AREA	FT2	369.0	369.0	369.0
TOTAL SAMPLING TIME	MIN	147.	147.	147.
GAS SAMPLE VOL METER COND	FT3	168.72	70.20	72.06
MOISTURE COLLECTED	GRAMS	228.00	164.00	121.00
SAMPLE WEIGHT	GRAMS	0.0732	0.0495	0.0427
AVG STACK TEMP	DEG R	771.2	786.1	798.4
AVG GAS METER TEMP	DEG R	548.1	547.0	564.2
AVG SQ ROOT DELTA P	IN H20	0.53	0.51	0.52
AVG DELTA H	IN H20	3.48	0.69	0.71
AVG LOAD	MW	350.8	349.7	350.2
AVG COAL FLOW RATE	TON/HR	186.5	187.7	186.2
AVG BTU COAL	BTU/LB	8932.	8872.	8896.
AVG HEAT RATE	10**6 BTU/HR	3331.0	3331.4	3313.8
AVG OPACITY	%	2.3	1.0	2.1
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	140.106	58.190	58.266
PERCENT MOISTURE	VOL %	7.14	11.75	8.93
WET STACK GAS MOL WT		29.55	28.98	29.31
ABSOLUTE DUCT PRESS	IN HG	23.97	24.08	24.02
AVG DUCT VELOCITY	FT/SEC	39.47	39.05	39.69
DUCT FLOW DRY STD COND	10**6 DSCFM	0.445	0.412	0.425
DUCT FLOW WET STACK COND	10**6 CFM	0.874	0.864	0.879
PARTICULATE CONC	GRAINS/SCF	0.0081	0.0131	0.0113
PART EMISS RATE	LB/HR	24.09	38.65	33.50
PART EMISS RATE	LB/10**6 BTU	0.0072	0.0116	0.0101
ISOKINETIC VARIATION	%	98.77	95.36	92.69

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		EO4 4	WO1 5	WO2 6
ORSAT GAS ANALYSIS				
CO2	%	13.73	12.87	13.53
CO	%	0.0	0.0	0.0
O2	%	5.30	6.16	5.56
N2	%	80.97	80.96	80.90
EXCESS AIR	%	32.97	40.53	35.24
DRY GAS MOL WT		30.41	30.31	30.39
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	25.91	26.07	26.18
STATIC PRESSURE	IN H2O	-29.90	-27.20	-27.20
NOZZLE AREA	FT2	.37158E-03	.81694E-03	.40952E-03
PITOT TUBE COEFFICIENT		0.840	0.860	0.860
DGMCF		0.980	0.991	0.991
DUCT CROSS SECT AREA	FT2	369.0	369.0	369.0
TOTAL SAMPLING TIME	MIN	147.	146.	147.
GAS SAMPLE VOL METER COND	FT3	78.78	150.85	71.46
MOISTURE COLLECTED	GRAMS	195.00	248.00	153.00
SAMPLE WEIGHT	GRAMS	0.0307	0.1005	0.1471
AVG STACK TEMP	DEG R	796.6	783.0	779.2
AVG GAS METER TEMP	DEG R	531.9	546.0	550.7
AVG SQ ROOT DELTA P	IN H2O	0.54	0.49	0.48
AVG DELTA H	IN H2O	0.75	2.97	0.73
AVG LOAD	MW	345.0	350.8	349.7
AVG COAL FLOW RATE	TON/HR	184.7	186.5	187.7
AVG BTU COAL	BTU/LB	8840.	8932.	8872.
AVG HEAT RATE	10**6 BTU/HR	3264.9	3331.0	3331.4
AVG OPACITY	%	2.2	2.3	1.9
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	66.494	126.984	59.508
PERCENT MOISTURE	VOL %	12.17	8.45	10.83
WET STACK GAS MOL WT		28.90	29.27	29.05
ABSOLUTE DUCT PRESS	IN HG	23.72	24.07	24.18
AVG DUCT VELOCITY	FT/SEC	41.56	38.22	37.06
DUCT FLOW DRY STD COND	10**6 DSCFM	0.425	0.420	0.401
DUCT FLOW WET STACK COND	10**6 CFM	0.920	0.849	0.821
PARTICULATE CONC	GRAINS/SCF	0.0071	0.0122	0.0381
PART EMISS RATE	LB/HR	21.18	41.98	125.05
PART EMISS RATE	LB/10**6 BTU	0.0065	0.0126	0.0375
ISOKINETIC VARIATION	%	105.82	93.48	91.07

B-23

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

		WO3	WO4
TEST NUMBER		7	8
ORSAT GAS ANALYSIS			
CO2	%	13.40	13.56
CO	%	0.0	0.0
O2	%	5.37	5.53
N2	%	81.23	80.90
EXCESS AIR	%	33.41	34.98
DRY GAS MOL WT		30.36	30.39
PARTICULATE DATA			
BAROMETRIC PRESSURE	IN HG	26.12	25.91
STATIC PRESSURE	IN H20	-27.20	-27.20
NOZZLE AREA	FT2	.40952E-03	.40653E-03
PITOT TUBE COEFFICIENT		0.860	0.860
UGMCF		0.991	0.991
DUCT CROSS SECT AREA	FT2	369.0	369.0
TOTAL SAMPLING TIME	MIN	147.	148.
GAS SAMPLE VOL METER COND	FT3	66.97	80.27
MOISTURE COLLECTED	GRAMS	131.50	197.50
SAMPLE WEIGHT	GRAMS	0.0756	0.0905
AVG STACK TEMP	DEG R	793.0	782.6
AVG GAS METER TEMP	DEG R	568.3	535.2
AVG SQ ROOT DELTA P	IN H20	0.48	0.50
AVG DELTA H	IN H20	0.75	0.78
AVG LOAD	MW	350.2	345.0
AVG COAL FLOW RATE	TON/HR	186.2	184.7
AVG BTU COAL	BTU/LB	8896.	8840.
AVG HEAT RATE	10**6 BTU/HR	3313.8	3264.9
AVG OPACITY	%	2.1	2.2
PARTICULATE RESULTS			
SAMPLE VOL DRY STD COND	FT3	53.922	68.097
PERCENT MOISTURE	VOL %	10.33	12.05
WET STACK GAS MOL WT		29.08	28.90
ABSOLUTE DUCT PRESS	IN HG	24.12	23.91
AVG DUCT VELOCITY	FT/SEC	37.85	39.05
DUCT FLOW DRY STD COND	10**6 DSCFM	0.403	0.410
DUCT FLOW WET STACK COND	10**6 CFM	0.838	0.864
PARTICULATE CONC	GRAINS/SCF	0.0216	0.0205
PART EMISS RATE	LB/HR	68.62	65.04
PART EMISS RATE	LB/10**6 BTU	0.0207	0.0199
ISOKINETIC VARIATION	%	81.97	101.89

PUBLIC FILTER SYSTEM SUMMARY LOG - PAGE 2 [illegible]/[illegible]/80 0:31:10

1 INLET PART LOADING EAST
2 INLET PART LOADING EAST
3 INLET PART LOADING WEST
4 INLET PART LOADING WEST
5 OUTLET PART LOADING EAST
6 OUTLET PART LOADING EAST
7 OUTLET PART LOADING WEST
8 OUTLET PART LOADING WEST
9 PART REMOVAL EFF EAST
10 PART REMOVAL EFF WEST
11 INLET SO2 EAST 1 HR AVG
12 INLET SO2 EAST 1 HR AVG
13 INLET SO2 WEST 1 HR AVG
14 INLET SO2 WEST 1 HR AVG
15
16
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	GR/ SCF	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU
1:00	-4.8	0.01	-9.4	0.01	-2.1339	0.0023	73.7088	0.4323	55.740	61.238	-8.12	0.02	204.45	0.49
2:00	-4.7	0.01	-9.5	0.01	-2.1547	0.0023	74.4932	0.4310	55.740	60.645	-8.05	0.02	190.36	0.47
3:00	-4.9	0.01	-9.3	0.01	-2.1563	0.0023	57.9059	0.4303	55.732	65.508	-8.07	0.02	187.37	0.46
4:00	-4.9	0.01	-9.1	0.01	-2.1804	0.0023	62.1798	0.4255	55.747	67.170	-8.35	0.02	177.53	0.44
5:00	-5.4	0.01	10.2	0.01	-2.3913	0.0024	07.9021	0.4771	55.774	64.463	-8.72	0.02	185.49	0.47
6:00	-7.0	0.01	13.5	0.02	-3.0802	0.0033	36.5303	0.5131	55.751	64.978	-6.10	0.02	221.36	0.55
7:00	* 0.0	0.00	* 0.0	0.00	* 0.0000	0.0000	* 0.0000	0.0000	19.000	19.000	-5.48	0.01	222.44	0.55
8:00	-4.7	0.00	-8.3	0.01	-2.0433	0.0021	47.9819	0.3972	55.748	69.892	-8.27	0.02	181.79	0.45
9:00	-4.6	0.00	-8.7	0.01	-2.0450	0.0021	46.1994	0.3971	55.825	64.201	-7.91	0.02	184.88	0.46
10:00	-4.5	0.00	-8.7	0.01	-1.9875	0.0021	44.7053	0.3989	55.761	64.436	-8.44	0.02	185.33	0.45
11:00	-4.5	0.00	-8.8	0.01	-1.9753	0.0021	47.1707	0.3993	55.740	63.326	-8.24	0.02	190.09	0.46
12:00	-4.4	0.00	-8.9	0.01	-1.9625	0.0021	52.0613	0.3988	55.791	59.746	-8.61	0.02	183.86	0.45
13:00	-4.5	0.00	-8.8	0.01	-2.0082	0.0021	49.9676	0.3997	55.768	61.292	-8.24	0.02	194.23	0.47
14:00	-4.5	0.00	-8.9	0.01	-1.9962	0.0021	52.9401	0.3993	55.761	61.574	-8.29	0.02	191.49	0.47
15:00	-4.5	0.00	-9.0	0.01	-1.9780	0.0021	57.2310	0.4001	55.753	63.895	-8.16	0.02	190.02	0.46
16:00	-4.5	0.00	-9.1	0.01	-1.9819	0.0021	59.6185	0.3986	55.783	62.062	-9.10	0.02	199.44	0.49
17:00	-4.4	0.00	-8.9	0.01	-2.0157	0.0021	52.6132	0.3944	55.764	66.271	-8.48	0.02	207.97	0.51
18:00	-4.4	0.00	-8.7	0.01	-1.9597	0.0021	46.1475	0.3945	55.756	62.220	-8.02	0.02	197.35	0.48
19:00	-4.4	0.00	-8.8	0.01	-1.9486	0.0021	47.0167	0.3908	55.764	61.413	-8.36	0.02	185.50	0.44
20:00	-4.4	0.00	-8.9	0.01	-1.9325	0.0021	51.6335	0.3882	55.725	64.152	-9.06	0.02	162.04	0.41
21:00	-4.3	0.00	-8.9	0.01	-1.9104	0.0021	51.7596	0.3859	55.773	60.543	-8.43	0.02	165.73	0.39
22:00	-4.4	0.00	-8.9	0.01	-1.9280	0.0021	52.6851	0.3905	55.755	63.196	-8.48	0.02	151.22	0.36
23:00	-4.4	0.00	-8.4	0.01	-1.9544	0.0021	41.7045	0.3921	55.774	61.314	-9.14	0.02	150.10	0.36
24:00	-5.5	0.01	10.8	0.01	-2.4907	0.0028	29.8082	0.5183	55.840	65.650	-7.98	0.02	168.50	0.41

B-25

PHASE IV

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 3 8/27/80 0:32:18

1 OUTLET SO2 EAST 1 HR AVG
2 OUTLET SO2 EAST 1 HR AVG
3 OUTLET SO2 WEST 1 HR AVG
4 OUTLET SO2 WEST 1 HR AVG
5 SO2 REM EFF EAST 1 HR AVG
6 SO2 REM EFF WEST 1 HR AVG
7 INLET NOX EAST 1 HR AVG
8 INLET NOX EAST 1 HR AVG
9 INLET NOX WEST 1 HR AVG
10 INLET NOX WEST 1 HR AVG
11 OUTLET NOX EAST 1 HR AVG
12 OUTLET NOX EAST 1 HR AVG
13 OUTLET NOX WEST 1 HR AVG
14 OUTLET NOX WEST 1 HR AVG
15 NOX REMOVAL EFF EAST
16 NOX REMOVAL EFF WEST
17
18

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	PPM	LB/ MMBTU	%	%
1:00	231.8	0.55	196.6	0.43	998.23	2.70	-3.9	0.01	171.9	0.30	234.2	0.40	199.9	0.35	235.59	-17.68
2:00	225.7	0.52	186.7	0.47	939.21	0.55	-1.7	0.00	167.8	0.30	230.3	0.38	195.3	0.35	645.20	-18.36
3:00	203.9	0.47	186.5	0.46	653.09	-1.25	-4.4	0.01	188.3	0.33	234.7	0.39	211.5	0.38	492.84	-14.22
4:00	202.6	0.47	186.4	0.47	555.68	-6.74	-4.6	0.01	191.3	0.34	239.9	0.40	213.1	0.38	405.34	-13.29
5:00	223.0	0.52	198.8	0.51	690.64	-9.47	-2.8	0.00	172.6	0.31	244.0	0.41	215.5	0.40	055.60	-27.40
6:00	230.4	0.59	251.8	0.63	936.49	-14.93	-2.0	0.00	66.2	0.12	206.3	0.38	187.3	0.34	622.01	185.98
7:00	249.8	0.58	245.6	0.62	711.34	-12.47	-0.7	0.00	108.5	0.19	225.0	0.38	211.3	0.39	510.70	-98.32
8:00	*226.9	0.52	200.1	0.51	801.71	-12.39	-0.2	0.00	196.6	0.35	256.5	0.42	230.0	0.42	251.69	-19.46
9:00	239.9	0.54	186.6	0.47	172.48	-2.91	-0.9	0.00	211.2	0.37	258.0	0.42	224.8	0.41	070.91	-8.55
10:00	232.0	0.53	181.4	0.45	888.63	0.25	-0.8	0.00	215.5	0.38	248.7	0.40	222.1	0.40	724.11	-5.04
11:00	227.2	0.52	178.7	0.44	891.14	4.47	-1.9	0.00	221.0	0.39	246.7	0.41	220.8	0.39	453.78	-1.56
12:00	214.5	0.49	169.3	0.42	616.44	6.34	-1.9	0.00	228.6	0.40	243.8	0.40	219.8	0.39	751.81	2.23
13:00	199.1	0.45	169.0	0.42	557.35	11.67	-2.4	0.00	231.9	0.41	239.6	0.39	224.0	0.40	277.49	1.95
14:00	180.6	0.41	165.2	0.41	298.30	12.37	-2.5	0.00	237.6	0.42	234.7	0.38	225.5	0.40	756.73	3.61
15:00	162.3	0.37	163.2	0.40	116.89	12.65	-3.4	0.01	243.3	0.42	229.5	0.38	231.1	0.41	856.46	3.39
16:00	151.8	0.34	163.1	0.40	790.28	17.00	-2.4	0.00	248.8	0.44	227.5	0.37	235.0	0.42	840.75	4.16
17:00	135.6	0.31	166.2	0.41	710.67	18.70	-2.2	0.00	251.0	0.44	223.7	0.36	244.1	0.43	477.65	1.04
18:00	151.0	0.35	167.1	0.41	010.96	13.94	-2.2	0.00	241.3	0.42	222.2	0.36	232.5	0.41	352.06	2.10
19:00	252.8	0.58	176.0	0.43	997.50	3.54	-2.0	0.00	229.3	0.39	257.9	0.43	211.9	0.37	522.24	6.08
20:00	302.7	0.69	173.2	0.43	456.08	-4.03	-2.1	0.00	248.8	0.43	283.5	0.46	214.5	0.38	070.03	12.46
21:00	294.1	0.69	175.4	0.42	638.62	-7.23	-1.4	0.00	266.6	0.45	287.1	0.49	225.7	0.39	793.18	14.21
22:00	297.9	0.69	171.2	0.42	665.68	-14.91	-1.4	0.00	259.4	0.45	291.1	0.48	228.0	0.40	713.90	10.78
23:00	284.7	0.66	182.3	0.45	257.20	-23.95	-3.6	0.01	231.5	0.40	274.8	0.44	223.7	0.39	021.16	1.37
24:00	327.5	0.81	205.6	0.50	233.35	-21.68	-2.1	0.00	161.0	0.28	255.5	0.45	184.4	0.32	527.81	-14.46

B-26

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 5 8/27/80 0:34:23

1 OUTLET DAMPER COMP# 1 EAST
2 OUTLET DAMPER COMP# 2 EAST
3 OUTLET DAMPER COMP# 3 EAST
4 OUTLET DAMPER COMP# 4 EAST
5 OUTLET DAMPER COMP# 5 EAST
6 OUTLET DAMPER COMP# 6 EAST
7 OUTLET DAMPER COMP# 7 EAST
8 OUTLET DAMPER COMP# 8 EAST
9 OUTLET DAMPER COMP# 9 EAST
10 OUTLET DAMPER COMP#10 EAST
11 OUTLET DAMPER COMP#11 EAST
12 OUTLET DAMPER COMP#12 EAST
13 OUTLET DAMPER COMP#13 EAST
14 OUTLET DAMPER COMP#14 EAST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	COMP 1	COMP 2	COMP 3	COMP 4	COMP 5	COMP 6	COMP 7	COMP 8	COMP 9	COMP 10	COMP 11	COMP 12	COMP 13	COMP 14
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
19:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
20:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
21:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
22:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
23:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
24:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

87

FABRIC FILTER SYSTEM SUMMARY LOG - PAGE 6 3/27/80 0:35:32

1 OUTLET DAMPER COMP#15 WEST
2 OUTLET DAMPER COMP#16 WEST
3 OUTLET DAMPER COMP#17 WEST
4 OUTLET DAMPER COMP#18 WEST
5 OUTLET DAMPER COMP#19 WEST
6 OUTLET DAMPER COMP#20 WEST
7 OUTLET DAMPER COMP#21 WEST
8 OUTLET DAMPER COMP#22 WEST
9 OUTLET DAMPER COMP#23 WEST
10 OUTLET DAMPER COMP#24 WEST
11 OUTLET DAMPER COMP#25 WEST
12 OUTLET DAMPER COMP#26 WEST
13 OUTLET DAMPER COMP#27 WEST
14 OUTLET DAMPER COMP#28 WEST
15 **********
16 * YES IN SERVICE FOR THE HR*
17 * NO OUT SERVICE FOR THE HR*
18 **********

	1 COMP 15	2 COMP 16	3 COMP 17	4 COMP 18	5 COMP 19	6 COMP 20	7 COMP 21	8 COMP 22	9 COMP 23	10 COMP 24	11 COMP 25	12 COMP 26	13 COMP 27	14 COMP 28
1:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
4:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
5:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
6:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
7:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
8:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
9:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
12:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
13:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
14:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
15:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
16:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
17:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
18:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
19:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
20:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
21:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
22:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
23:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
24:00	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		EI1 1	EI2 2	EI3 3
ORSAT GAS ANALYSIS				
CO2	%	14.10	13.96	14.73
CO	%	0.0	0.0	0.0
O2	%	4.80	4.86	4.80
N2	%	81.10	81.16	80.46
EXCESS AIR	%	28.90	29.37	29.19
DRY GAS MOL WT		30.45	30.43	30.55
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.44	26.41	26.42
STATIC PRESSURE	IN H2O	-17.70	-17.70	-17.70
NOZZLE AREA	FT2	.38300E-03	.38300E-03	.38300E-03
PITOT TUBE COEFFICIENT		0.837	0.837	0.837
DGMCF		1.001	1.001	1.001
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	147.	147.	147.
GAS SAMPLE VOL METER COND	FT3	110.02	110.82	111.03
MOISTURE COLLECTED	GRAMS	297.00	288.00	287.00
SAMPLE WEIGHT	GRAMS	9.9146	11.3116	8.1110
AVG STACK TEMP	DEG R	821.9	827.9	831.8
AVG GAS METER TEMP	DEG R	554.8	558.5	561.1
AVG SQ ROOT DELTA P	IN H2O	0.79	0.78	0.79
AVG DELTA H	IN H2O	1.69	1.66	1.69
AVG LOAD	MW	349.5	349.5	349.5
AVG COAL FLOW RATE	TON/HR	184.3	185.7	186.8
AVG BTU COAL	BTU/LB	8811.	8771.	8780.
AVG HEAT RATE	10**6 BTU/HR	3247.7	3258.4	3281.1
AVG OPACITY	%	8.3	8.3	8.1
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	93.013	92.964	92.754
PERCENT MOISTURE	VOL %	13.10	12.76	12.75
WET STACK GAS MOL WT		28.82	28.94	28.95
ABSOLUTE DUCT PRESS	IN HG	25.14	25.11	25.12
AVG DUCT VELOCITY	FT/SEC	59.94	59.66	60.29
DUCT FLOW DRY STD COND	10**6 DSCFM	0.415	0.411	0.414
DUCT FLOW WET STACK COND	10**6 CFM	0.885	0.881	0.890
PARTICULATE CONC	GRAINS/SCF	1.6447	1.8775	1.3493
PART EMISS RATE	LB/HR	4684.30	5346.23	3867.17
PART EMISS RATE	LB/10**6 BTU	1.4423	1.6407	1.1786
ISOKINETIC VARIATION	%	97.98	98.83	97.97

B29

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		#11 4	#12 5	#13 6
ORSAT GAS ANALYSIS				
CO2	%	13.28	13.25	13.40
CO	%	0.0	0.0	0.0
O2	%	6.05	5.92	5.90
N2	%	80.67	80.82	80.70
EXCESS AIR	%	39.68	38.44	38.30
DRY GAS MOL WT		30.37	30.36	30.38
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.44	26.41	26.42
STATIC PRESSURE	IN H2O	-19.00	-19.00	-18.40
NOZZLE AREA	FT2	.38300E-03	.38300E-03	.38300E-03
PITOT TUBE COEFFICIENT		0.845	0.845	0.845
DGMCF		0.997	0.997	0.997
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	147.	148.	147.
GAS SAMPLE VOL METER COND	FT3	114.46	114.03	118.95
MOISTURE COLLECTED	GRAMS	283.00	282.00	276.00
SAMPLE WEIGHT	GRAMS	12.9352	10.2885	9.2629
AVG STACK TEMP	DEG R	788.2	793.4	795.9
AVG GAS METER TEMP	DEG R	554.7	559.1	559.9
AVG SQ ROOT DELTA P	IN H2O	0.80	0.81	0.80
AVG DELTA H	IN H2O	2.00	2.05	2.03
AVG LOAD	MW	349.5	349.5	349.5
AVG COAL FLOW RATE	TON/HR	184.3	185.7	186.8
AVG BTU COAL	BTU/LB	8811.	8771.	8780.
AVG HEAT RATE	10**6 BTU/HR	3247.7	3258.4	3281.1
AVG CPACITY	%	8.3	8.3	8.1
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	96.487	95.267	99.283
PERCENT MOISTURE	VOL %	12.17	12.27	11.61
WET STACK GAS MOL WT		28.86	28.84	28.94
ABSOLUTE DUCT PRESS	IN HG	25.04	25.01	25.07
AVG DUCT VELOCITY	FT/SEC	60.18	61.00	60.82
DUCT FLOW DRY STD COND	10**6 DSCFM	0.437	0.439	0.441
DUCT FLOW WET STACK COND	10**6 CFM	0.888	0.900	0.898
PARTICULATE CONC	GRAINS/SCF	1.9246	1.6664	1.4396
PART EMISS RATE	LB/HR	6301.20	5438.70	4778.37
PART EMISS RATE	LB/10**6 BTU	1.9587	1.6691	1.4563
ISOKINETIC VARIATION	%	96.40	99.11	90.38

8 30

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

		ST1	ST2	ST3
TEST NUMBER		7	8	9
ORSAT GAS ANALYSIS				
CO2	%	13.26	13.36	13.38
CO	%	0.0	0.0	0.0
O2	%	5.81	5.66	6.09
N2	%	80.92	80.97	80.53
EXCESS AIR	%	37.40	36.06	40.10
DRY GAS MOL WT		30.35	30.36	30.39
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.34	26.31	26.32
STATIC PRESSURE	IN H2O	-0.90	-0.90	-0.90
NOZZLE AREA	FT2	.16700E-03	.16700E-03	.16700E-03
PITOT TUBE COEFFICIENT		0.871	0.871	0.871
DGMCF		0.971	0.971	0.971
DUCT CROSS SECT AREA	FT2	339.8	339.8	339.8
TOTAL SAMPLING TIME	MIN	120.	120.	120.
GAS SAMPLE VOL METER COND	FT3	53.49	56.89	57.81
MOISTURE COLLECTED	GRAMS	130.90	139.30	138.50
SAMPLE WEIGHT	GRAMS	0.0465	0.0289	0.0469
AVG STACK TEMP	DEG R	810.4	820.3	814.6
AVG GAS METER TEMP	DEG R	537.5	543.1	541.1
AVG SQ ROOT DELTA P	IN H2O	1.08	1.07	1.09
AVG DELTA H	IN H2O	1.10	1.14	1.15
AVG LOAD	MW	349.5	349.5	349.5
AVG COAL FLOW RATE	TON/HR	184.3	185.7	186.8
AVG BTU COAL	BTU/LB	8811.	8771.	8780.
AVG HEAT RATE	10**6 BTU/HR	3247.7	3258.4	3281.1
AVG CPACITY	%	8.3	8.3	8.1
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	45.035	47.351	48.326
PERCENT MOISTURE	VOL %	12.07	12.20	11.92
WET STACK GAS MOL WT		28.86	28.86	28.91
ABSOLUTE DUCT PRESS	IN HG	26.27	26.24	26.26
AVG DUCT VELOCITY	FT/SEC	83.12	83.03	83.97
DUCT FLOW DRY STD COND	10**6 DSCFM	0.853	0.839	0.858
DUCT FLOW WET STACK COND	10**6 CFM	1.695	1.693	1.712
PARTICULATE CONC	GRAINS/SCF	0.0161	0.0094	0.0150
PART EMISS RATE	LB/HR	131.11	58.50	96.95
PART EMISS RATE	LB/10**6 BTU	0.0311	0.0180	0.0295
ISOKINETIC VARIATION	%	89.60	95.71	95.56

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		E11 1	E12 2	E13 3
ORSAT GAS ANALYSIS				
CO2	%	12.36	14.40	13.02
CO	%	0.0	0.0	0.0
O2	%	6.98	4.84	6.30
N2	%	80.65	80.76	80.68
EXCESS AIR	%	48.82	29.33	42.00
DRY GAS MOL WT		30.26	30.50	30.34
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.28	26.21	26.17
STATIC PRESSURE	IN H2O	-17.76	-16.30	-16.30
NOZZLE AREA	FT2	.38300E-03	.38450E-03	.38302E-03
PITOT TUBE COEFFICIENT		0.802	0.802	0.802
DGMCF		0.987	0.987	0.987
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	147.	147.	147.
GAS SAMPLE VOL METER COND	FT3	126.53	115.24	116.11
MOISTURE COLLECTED	GRAMS	67.50	287.00	248.00
SAMPLE WEIGHT	GRAMS	0.9521	11.6345	8.3122
AVG STACK TEMP	DEG R	817.8	818.4	822.4
AVG GAS METER TEMP	DEG R	570.8	565.6	572.6
AVG SQ ROOT DELTA P	IN H2O	0.81	0.80	0.80
AVG DELTA H	IN H2O	2.12	1.87	1.85
AVG LOAD	MW	355.2	353.0	356.0
AVG COAL FLOW RATE	TON/HR	189.1	187.9	187.6
AVG BTU COAL	BTU/LB	8736.	8774.	8777.
AVG HEAT RATE	10**6 BTU/HR	3304.8	3298.1	3293.6
AVG CPACITY	%	2.1	2.4	2.5
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	102.035	93.463	92.874
PERCENT MOISTURE	VOL %	3.03	12.67	11.20
WET STACK GAS MOL WT		29.89	28.91	28.95
ABSOLUTE DUCT PRESS	IN HG	24.98	25.01	24.97
AVG DUCT VELOCITY	FT/SEC	57.83	58.33	58.72
DUCT FLOW DRY STD COND	10**6 DSCFM	0.446	0.406	0.412
DUCT FLOW WET STACK COND	10**6 CFM	0.854	0.861	0.867
PARTICULATE CONC	GRAINS/SCF	0.1440	1.9208	1.3810
PART EMISS RATE	LB/HR	509.22	5679.04	4581.36
PART EMISS RATE	LB/10**6 BTU	0.1541	1.7219	1.3910
ISOKINETIC VARIATION	%	99.99	100.34	98.42

8-39

SPS/GCA

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

TEST NUMBER		#11 4	#12 5	#13 6
ORSAT GAS ANALYSIS				
CO2	%	14.00	13.26	13.95
CO	%	0.0	0.0	0.0
O2	%	5.20	6.24	6.06
N2	%	80.80	80.49	79.99
EXCESS AIR	%	32.24	41.62	45.30
DRY GAS MOL WT		30.45	30.37	30.47
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.28	26.21	26.17
STATIC PRESSURE	IN H2O	-19.05	-17.00	-16.30
NOZZLE AREA	FT2	.37730E-03	.37730E-03	.37730E-03
PITOT TUBE COEFFICIENT		0.824	0.824	0.824
DGMCF		1.002	1.002	1.002
DUCT CROSS SECT AREA	FT2	246.0	246.0	246.0
TOTAL SAMPLING TIME	MIN	147.	147.	147.
GAS SAMPLE VOL METER COND	FT3	118.54	111.79	112.11
MOISTURE COLLECTED	GRAMS	306.00	273.50	262.50
SAMPLE WEIGHT	GRAMS	14.2732	11.0003	7.6581
AVG STACK TEMP	DEG R	821.1	813.1	819.1
AVG GAS METER TEMP	DEG R	577.3	571.2	577.0
AVG SQ ROOT DELTA P	IN H2O	0.83	0.79	0.79
AVG DELTA H	IN H2O	2.15	1.85	1.85
AVG LOAD	MW	355.2	355.0	350.0
AVG COAL FLOW RATE	TON/HR	189.1	187.9	187.6
AVG BTU COAL	BTU/LB	8736.	8774.	8777.
AVG HEAT RATE	10**6 BTU/HR	3304.8	3298.1	3293.6
AVG OPACITY	%	2.1	2.4	2.5
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	95.949	91.142	90.336
PERCENT MOISTURE	VOL %	13.09	12.41	12.07
WET STACK GAS MOL WT		28.82	28.84	28.97
ABSOLUTE DUCT PRESS	IN HG	24.88	24.96	24.97
AVG DUCT VELOCITY	FT/SEC	62.77	58.94	58.96
DUCT FLOW DRY STD COND	10**6 DSCFM	0.431	0.413	0.412
DUCT FLOW WET STACK COND	10**6 CFM	0.926	0.870	0.870
PARTICULATE CONC	GRAINS/SCF	2.2953	1.8623	1.3081
PART EMISS RATE	LB/HR	7072.36	6108.80	4310.18
PART EMISS RATE	LB/10**6 BTU	2.1400	1.8522	1.3087
ISOKINETIC VARIATION	%	98.86	97.97	97.35

B-33

SOUTHWESTERN PUBLIC SERVICE CO.

PARTICULATE TEST SUMMARY

		S1	S2	S3
TEST NUMBER		7	8	9
ORSAT GAS ANALYSIS				
CO2	%	12.50	13.50	13.35
CO	%	0.0	0.0	0.0
O2	%	6.69	5.85	5.97
N2	%	80.80	80.56	80.67
EXCESS AIR	%	45.69	37.94	38.99
DRY GAS MOL WT		30.27	30.41	30.37
PARTICULATE DATA				
BAROMETRIC PRESSURE	IN HG	26.18	26.11	26.07
STATIC PRESSURE	IN H2O	-1.00	-0.95	-0.97
NOZZLE AREA	FT2	.14140E-03	.14140E-03	.30121E-03
PITOT TUBE COEFFICIENT		0.780	0.780	0.780
DGMCF		0.949	0.949	0.949
DUCT CROSS SECT AREA	FT2	339.8	339.8	339.8
TOTAL SAMPLING TIME	MIN	120.	120.	120.
GAS SAMPLE VOL METER COND	FT3	57.01	46.60	99.36
MOISTURE COLLECTED	GRAMS	132.50	114.00	225.90
SAMPLE WEIGHT	GRAMS	0.0453	0.0471	0.0423
AVG STACK TEMP	DEG R	825.8	816.7	821.8
AVG GAS METER TEMP	DEG R	546.5	539.5	547.5
AVG SQ ROOT DELTA P	IN H2O	1.18	1.11	1.08
AVG DELTA H	IN H2O	1.12	1.00	1.81
AVG LOAD	MW	355.2	355.0	356.0
AVG COAL FLOW RATE	TON/HR	189.1	187.9	187.6
AVG BTU COAL	BTU/LB	8736.	8774.	8777.
AVG HEAT RATE	10**6 BTU/HR	3304.8	3298.1	3293.6
AVG OPACITY	%	2.1	2.4	2.5
PARTICULATE RESULTS				
SAMPLE VOL DRY STD COND	FT3	45.870	37.860	79.597
PERCENT MOISTURE	VOL %	12.01	12.45	11.82
WET STACK GAS MOL WT		28.80	28.86	28.91
ABSOLUTE DUCT PRESS	IN HG	26.11	26.04	26.00
AVG DUCT VELOCITY	FT/SEC	82.59	77.17	75.01
DUCT FLOW DRY STD COND	10**6 DSCFM	0.827	0.775	0.753
DUCT FLOW WET STACK COND	10**6 CFM	1.684	1.573	1.529
PARTICULATE CONC	GRAINS/SCF	0.0152	0.0192	0.0082
PART EMISS RATE	LB/HR	104.62	121.91	53.44
PART EMISS RATE	LB/10**6 BTU	0.0317	0.0370	0.0162
ISOKINETIC VARIATION	%	111.16	97.84	99.41

B-34

Appendix C

Field Notes

Representative Field Notes
Phase III

Test Report for March, 1980, EPA Baghouse Study

3/24/80

1. West outlets SO_2 impingers being transferred forward, bad check valve

2. Electrical problem with hot box-east outlet. Rheostat in control box replaced.

3. Leak check problem on east outlet initially.

4. Hot box/cold box connector only are caused glassware to be washed each time (stack).

5. Hot box on east inlet hit conduit for pilot baghouse during SO_2 sample #6, causing it to be damaged and caused the probe liner to partially come out of probe. After hot box was replaced, an acceptable leak check could not be obtained. After delaying other stations for about an hour. It was decided to proceed without the east inlet.

6. While the east inlet was having problems, the west outlet could not obtain an acceptable leak rate. At the same time the east inlet was not being sampled, it was decided not to sample the west outlet. While other stations were sampling it was discovered that a faulty connection on the umbilical cord was the problem. This was tightened and the problem was solved.

7. At about 6:30, it was noticed on the opacity chart that an intermittent spike was developing. This aroused suspicion of a broken bag.

3/25/80

1. The unit was confirmed to have a broken bag in compartment #23. After inspection two broken bags were discovered. These bags were removed and the thimbles were blanked off.

2. The unit momentarily tripped and caused unstable boiler operations.

3. The stack had difficulty leak checking initially. The umbilical cord was found to be leaking at the cold box connection.

4. The west inlet hot box hit the ladder cage and caused it to be damaged. This resulted in the west inlet having to change out all glass ware and starting over. This caused us to be about an hour behind the other stations.

5. A unit went down at Plant X causing Harrington to pick up some load. The load was raised from 350 MW for a short while and then returned to 350 MW.

6. The east inlet sampled the last point of the first point for only two minutes. This was noted and was connected on the remaining ports.

7. Halfway through the first run on the west inlet the fitted disc collapsed causing the filter to break and allow particulate to enter the umbilical cord and impingers. As a result the test run was aborted at this sample station.

Representative Field Notes

BAGHOUSE STUDY
PHASE IV

1. SO_2 on Tuesday OK; particulate on Wednesday Run #1 west inlet at end of first port, we had to replace filters because of of a wrinkle that developed. No particulate was expected to have passed filter; Run #2 - prior to sampling the west inlet, we tore the filer and interchanged reagents in impingers. Both hot and cold boxes were replaced prior to sampling. The east inlet filter became torn during the second part of the second point. The filters assembly was replaced at that point and the run resumed. Only a small amount of dust leaked past the filter; Run #3 - No significant problems.

2. See Richard Chambers report for baghouse status.

3. Prior to the testing on Tuesday, five bags in compartment 27 were found to have holes. This caused the opacity to be elevated. During the testing on TW&T the opacity was running about 8% and an occasional 10%.